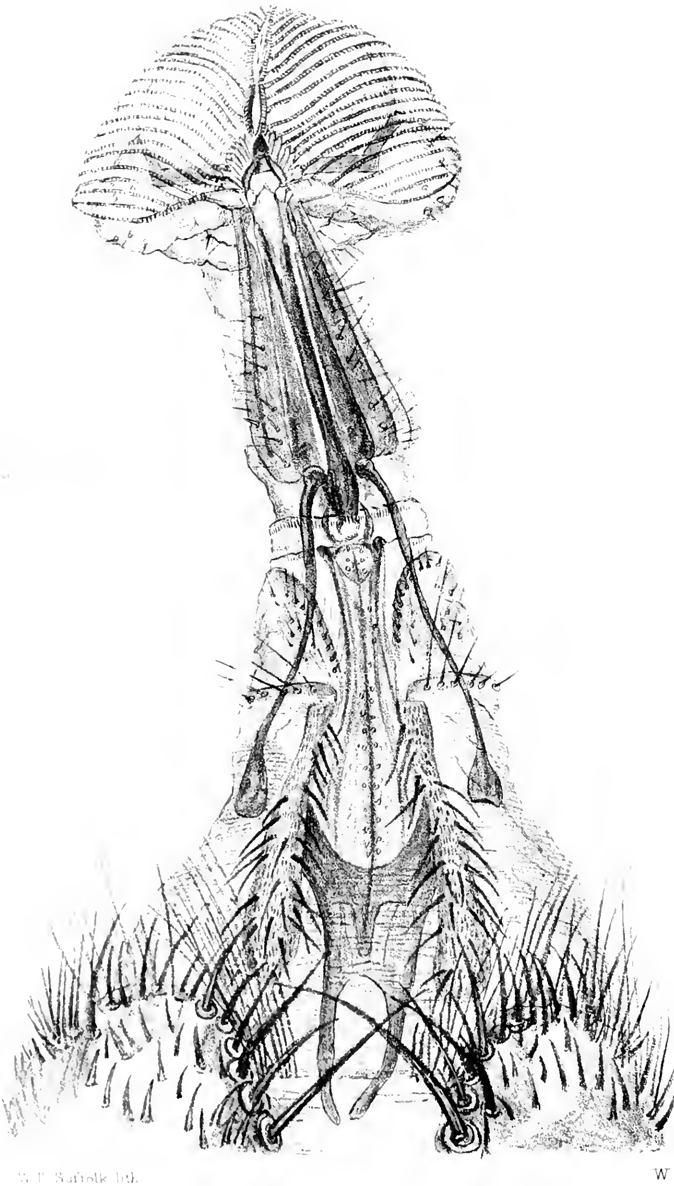
~~126 8~~

Plate IX.



B. T. Lowne del. ad nat.   S. P. Suffolk lith.   W. West imp.

Skeleton of the Proboscis of the Blow Fly

See pp. 126 & 190

THE JOURNAL

OF THE

QUEKETT MICROSCOPICAL CLUB.

VOL. I.

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BY
ROBERT HARDWICKE, 192, PICCADILLY.

DESCRIPTION OF PLATE IX.—*(Frontispiece.)*

Represents the dorsal aspect of the fly's proboscis, mounted in balsam without pressure, magnified about 40 diameters, and it is intended to shew the relations of the several parts. The lips are more inflated than is natural during life, a result which cannot be avoided in preparations like that from which the accompanying plate is taken.

ERRATA IN VOL. I.

Page 77, line 8 from bottom, for "varieties" read "rarities."
Page 79, line 11 from top, for "place" read "plane."
Page 135, after line 13, insert Bushey Park, May 2nd.

INTRODUCTION TO VOL. I.

Soon after the formation of the Quekett Microscopical Club, it was thought desirable that a permanent record of its proceedings should be formed, and that this should be done in such a manner as to maintain the control of the publication entirely in the hands of the committee and to confine it to the purpose for which it was intended.

The following pages therefore contain all the papers read before the Club during the last two years (with the exception of one or two published elsewhere), together with reports of discussions arising thereon. They also contain notices of apparatus and objects exhibited and other matters of Microscopic interest which may have been brought before the members.

September, 1869.

THE JOURNAL

OF THE

Quekett Microscopical Club.

On Universal Microscopic Admeasurement. By M. C. Cooke.

(*Read March 23rd*, 1866.)

The student who confines himself to English books, and shuts his eyes and ears to everything German, French, or Italian, will hardly have experienced any trouble or annoyance from the fact that, in describing a microscopical object, our continental neighbours universally employ a measurement which is as strange to us as their language, and expressed in terms of the value of which we have no experience. As now used, the dimensions of objects require translation as much as the language in which the description is written, with the disadvantage that the translation is not so readily made, or the power of translating so easily applied. We may suppose that the description of a minute object, be it diatom, insect, or mould, is written, as it always should be, in Latin; the measurements, however, though expressed sometimes in Latin, are more commonly read from a standard which is to us practically unknown.

It will be better, in the first instance, to look over the map of the world, and see in what civilised portions microscopic study is pursued, and what is the unit of measurement adopted, before we attempt any project to remedy the evil. We may fairly confine ourselves to Europe and America, without fear lest Asia and Africa should protest against being left out, because all the students in those regions will be "exports" from Europe or America. Australia is not much troubled with microscopical students. Her sons have not yet found time to stand for hours at one end of a microscope.

In Europe we may particularise Germany, in its widest sense, including all who speak or write the German Language, with whom could be included the few Scandinavians who pursue the study, and thus the German District would be held to mean all Northern Europe, from the shores of the German Ocean to the confines of Russia. Then France may be alluded to as including also Switzerland, and wherever the French tongue is employed. The South of Europe is represented only by Italy, for Austria belongs to Germany, the Turks are too idle, the Greeks too miserable, the Spaniards too intriguing, and the Portuguese too illiterate, to produce any contributions to microscopical literature. Of America we speak as restricted to North America, not including Mexico and Labrador, but the United States and Canada, where the English tongue prevails. So that the five microscopical centres are Britain, Germany, France, Italy, and America, extended or limited in application as already provided. From all parts of Germany and France the literature contains microscopical admeasurements with *the millemetre* as the "unit." In Britain and America the *inch* is the unit. Only a few years ago and the line was employed in France by some, whilst the millemetre was employed by others, and in Germany the *line* was chiefly used as the unit: this was sometimes the Prussian line and sometimes the Paris line. In fact, some of the states seem to have been independent of both, for we find, in Bohemia for instance, measurements employed, the unit of which corresponds with none of those alluded to. Time has wrought wonders, and now all the best German authorities—or those, at least, with which we have had to do—employ the millemetre. In France, too, the line is seldom thought of—I think it may safely be said, *never* employed. Very few Italians have devoted themselves to the microscope, or if they have, they have not contributed much to microscopic literature. Recently, Professor De Notaris has probably contributed most, and he invariably adopts the French millemetre for his standard, whence I have jumped to the conclusion that this measurement is most approved in Italy. The exceptions in the five centres, to which I have alluded, are so few that I think they do not militate against the conclusion that the Anglo-Saxon adheres to his inch and all the rest have adopted more or less the French millemetre.

I may perhaps be permitted, for the benefit of younger and less

experienced members, to state what the millemetre is. As the Englishman delights in halving and quartering, so the Frenchman drops naturally into decimals. The Paris metre is about 3 inches more than an English yard, and this, divided into 100 parts, gives centimetres, which are about equivalent to rather more than one-third of an English inch, each centimètre again divided into tenths gives millemetres, which are consequently the one-thousandth part of a metre, or of 39 inches. This millemetre is (roughly) equal to rather less than one-twenty-fifth of an English inch or $\frac{3937}{100000}$ of an inch, or, decimally expressed, .03937. The conversion therefore of English into French or French into English measurements is somewhat of a task, and liable to error.

The only method which can be adopted, is to multiply our expression of a millimetre in decimal fractions of an inch, by the decimals representing the French term under conversion; thus—to determine in English measurement 0.33 $^{m\,m}$ or $\frac{33}{100}$ of a millemetre, we must multiply .03937 by 0.33., which will give

$$\begin{array}{r} .03937 \\ 33 \\ \hline 11811 \\ 11811 \\ \hline .0129921 \end{array} \text{ of an inch.}$$

Taking care that there are as many decimal places to the right of the point as the sum of the decimal places in both terms.

It will be admitted that there is one plan, and one alone, which is superior to the most facile mode of conversion—namely, the adoption amongst all microscopists, both at home and abroad, of one unit of measurement. The question to be discussed is, how can this be attained? I think the answer a simple one. We already admit that the terms should be expressed in decimals, for the old plan of employing vulgar fractions, like other obsolete customs, will soon become a matter of history. The only disputed point is the *unit*, whether it shall be the inch or the millimetre, or yard and metre, if you will; for the yard is in reality our unit, of which the inch is merely the twelfth of the third, as the metre is the unit of Paris, save that we first divide it into three parts, and each into

B 2

twelve parts, and then commence decimals; true to the same spirit of contrariety whereby we take the sovereign as the unit, and then divide it into twenty parts, each into twelve, and then each again into four.

It will scarcely be supposed that all Europe will do *us* the *honour* of accepting either our inch, or our yard, as the standard; but we may do *ourselves honour* by following the example of Germany and Italy, and adopt the French standard, and recognise the millemetre as the unit of microscopical admeasurement. The fact that the metre, of which the millemetre is a portion, forms no part of our English measure, is no objection, because our experience of the length of a foot is of no service to us when we descend to the minute fractions of a microscopical object. In the latter case, we lose all appreciation of the foot or yard, and really establish some new standard, with which comparison is made, whether $\frac{1}{100}$ or $\frac{1}{1000}$ of an inch; and that becomes the standard with which, practically, we compare the dimensions of our object. In a month, we should be able to realise the relative dimensions of objects expressed in millemetres, even more readily than we now express them in thousandths of an inch, because the integer is one-twenty-fifth of the dimensions, and the fractions would come nearer to our experience; we have a much better conception of the 25th of a small object than of the 625th of a larger one. Let us, for example, take the frustule of a diatom, the length of which is $\frac{1}{500}$ of an inch. It requires a greater mental effort to realise the dimensions thus stated, than it would to realise the 20th of a millemetre. If we take more minute objects, the same argument will be even more applicable: a vegetable cell $\frac{1}{7000}$th of an inch is entirely out of our range of experiences in dimensions, as thus expressed, because we speak of thousandths oftener than we realise them. If it were stated as the $\frac{1}{280}$th of a millemetre, though now less familiar with the positive length of the millemetre than the inch, we should learn to realise the millemetre, and its 280th part, before we could compass $\frac{1}{7000}$ of an inch. There is another argument, which, I think, should have its weight. We are becoming microscopical as a nation, and by employing at once an unit known all over the continent, we introduce ourselves, and our literature, into an equal competition with their own; whereas, we now meet other Europeans at a disadvantage. We all know how generally the Latin language is employed in scientific

description, and with what facility a foreign *savant* catches up an English work written in Latin. It is equally as essential in microscopy, if we would not be behind all other nations, to adopt an admeasurement which shall be as universal as Latin, if we desire that the honour of Old England shall be maintained in the arts of peace in the eminence she has acquired in the art of war. Or else, when the time comes for the roar of the English cannon to be no more heard on the ocean, and the gleam of the English bayonet be no more seen on the hills, the name of England will fade away and be forgotten, or only remembered for her gunpowder and steel.

The machinery and labour which it would cost to introduce our pet inch as the standard all over the world, would be enormous. The power to introduce the European standard into all countries in which English is spoken, lies in the hands of a few: it rests with the microscopists of London. If they adopt it, those in the provinces will follow the example, and, in self-defence, our colonists will do the same; then if America does not think fit to fall in, she will become as isolated in microscopy as if she spoke and wrote in an unknown tongue.

If we reduce the question to the smallest number of words, we shall find it standing in something like the following form:—It is advisable that one and the same method of measuring and recording the dimensions of microscopic objects shall be adopted universally in all countries where microscopical observations are published.

It would be impracticable to attempt to introduce an entirely new standard, without the earnest co-operation of microscopists throughout Europe.

The adoption of any standard universally, independent of the value of its unit—if capable of accomplishment—would be a real benefit to microscopical science.

The French method is adopted by three-fifths of those interested, and is, therefore, the one which might be rendered universal with the least opposition.

The adoption of the millemetre as the standard is, therefore, incumbent upon British microscopists, if they would advance, and not obstruct, the cause which they are presumed to have at heart.

A few words on the mode by which I conceive it possible for this climax to be attained, and I have done.

The first step, and the one without which no others can be

taken, appeals to the trading community, as represented by the opticians. Every facility must be afforded for the purchase in this country of micrometers, carefully and correctly graduated to the French scale, on the same terms as English micrometers are now supplied. Because, unless the English amateur can obtain readily such a scale without sending specially, as I have been obliged to do, to Paris for the purpose, the majority will not take the trouble. It did not occur to me, until I had applied to one of our largest firms, that these micrometers are by no means easy to obtain in town.

This is in itself an evidence of how little we know practically of the French micrometers. Every member of the Q. M. C. should order one immediately of any optician who may be present in the room, and in the course of a week we should see French micrometers advertised, and the movement fairly and successfully commenced.

The next step—and one in which I purpose to march myself, even if I march alone—is to employ the French measurements, either with or without the English, in all published accounts of microscopical objects in which measurements are employed. We may rest assured that our object will be achieved more speedily by using the millemetral measurement only, and forgetting the inch, save as a matter of history. Every one who wishes well to the adoption of an universal admeasurement, should secretly and silently pledge himself, from this night forward and for ever, to abjure the inch.

Having done this, we should address an appeal to all microscopists in this country who are in the habit of publishing microscopical measurements, urging that by this means they will render their labours more valuable to students abroad, without detracting from their value at home.

Finally, we should draw up and forward a brief ultimatum printed in French or Latin, to the secretaries of all the leading academies and learned societies in Europe, requesting them to make the contents known amongst the *savans* of their own country; such ultimatum being to the effect that the adoption of the French method all over Europe would prove of inestimable value to men of science in all countries; that the effort is being made to establish it in Britain; and calling upon them to aid us in securing an universal system of measurement: and I feel confident in its success.

Now, gentlemen, I have laid before you all the details which I

think necessary, both as to the desirability, the practicability, and the mode of obtaining universality in one point connected with "our hobby." It is for you to decide whether the Q. M. C. shall bind the laurel wreath about its young but sturdy brow. It is for you to determine whether the honour of appealing on a common object to the microscopists of Europe shall be yours. It is for you to decide whether from England, whence many a missive has fled in days gone by, at which some individual nation has had cause to shudder, shall now hear from us, instead of the thunders of three-deckers, the peaceful welcome to a bond of brotherhood. It is for you to determine if the crowning effort of a year of glorious success shall be to prepare the way for the more glorious success of future years, by repudiating the use of figures which, to thousands of fellow-workers, from the Seine to the Danube, have no meaning; and to whom they are almost as barbarous as the hieroglyphics of Egypt, or the "pot-hooks and hangers" of Nineveh. It is your good fortune that this new Reform Bill should have been left for you to pass, and whilst learned societies at home are debating whether the markings of *Pleurosigma angulatum* can be resolved into "willow leaves," or dodecahedrons, or what relation the Maroons of Jamaica bear to the anthropomorphoid apes, that it should be left for you to indicate a practical good, for which a future generation shall have cause to be thankful. And, more than all, that you should have the credit of breaking through the sullen and selfish moroseness of Englishmen, and take the initiative of spreading abroad your arms from Sweden to Italy, and from Paris to St. Petersburg, to shake all fellow-workers by the hand, whether they date their ancestry to a Maximilian or Charlemagne, to Julius Cæsar or to Peter the Great.

It is but a small work in itself that I have invited you to perform, but who shall prophecy the end? A good work is sure to bring its own reward, and if by such a step you introduce yourselves into correspondence with microscopists abroad—if by these legitimate means, and in a good cause, you make yourselves known throughout the continent—the Quekett Club will not be forgotten; and when in future years the shelves of our library bend beneath the weight of contributions to microscopical science from all parts of the world, we shall hail them as the labours of friends, and rejoice that one of the first acts in our career was to smooth their road by kicking a stumbling block out of the way.

On Pseudo-scorpiones. By S. J. McIntire.

(Read Oct. 25th, 1867.)

Whilst making observations on Poduræ in the months of June, July, and August last year, my attention was frequently drawn to a small spider-like creature, about the size of a pin's head, that made its appearance under certain boards and brick-bats which were the favourite haunts of the black Podura. It was usually discovered nestled in some crevice, and its legs were packed so as to occupy very little space, but on being disturbed it would walk away steadily. If a capture were attempted, it made vigorous efforts to escape, running with great speed either backwards, forwards, or sideways. Its invariable occurrence in connection with Poduræ led me to think it sought the retreat of these insects for the purpose of preying upon them, and further acquaintance has confirmed me in that opinion.

A friend of mine in the country (at Theale), submitted to my inspection, in the early part of this year, a little reddish brown creature, like one I remembered to have seen in the late Mr. Richard Beck's possession, at Mr. Hardwicke's conversazione in Dec., 1865, and which Mr. Beck said had been sent him by a corn-dealer. On comparing this Pseudo-scorpion and many subsequent specimens with the creatures I was often finding, I soon learnt that the name *Chelifer*, which I had applied to my own captures in consequence of seeing several mounted slides so named, was incorrect; and reference to the books at hand caused me to come to the conclusion that the creature from Theale was a real Chelifer (probably *Chelifer Latreillei*), but the little persecutor of my Poduræ was an Obisium *(O. Orthodactylum)*.

In Wood's "Natural History," * the order is characterised as follows .—

PSEUDO-SCORPIONES.—Cephalothorax united to abdomen; abdomen ringed; palpi large, with pincers at top.

It is separated into genera.

Chelifer.—Eyes two; cephalothorax divided by transverse furrow.

* The Illustrated Natural History by the Rev. J. G. Wood, M.A., in Three Vols. Quarto. Routledge and Co.

Obisium.—Eyes four; cephalothorax not divided.

Of the two species of Chelifer and Obisium to which I refer, and which I am unable to name, the Chelifer is by far the larger. The structure of their feet enables both creatures to walk in an inverted position on the under-surface of glass, but the Obisium performs the feat best. I have often seen it thus walking, and have occasionally witnessed the Chelifer making the attempt.

For a long time I was under the impression that the Chelifer did not possess eyes at all, but was gifted with more than ordinarily acute hearing and touch, so as to compensate for this deficiency, and it was only after I had mounted one of the creatures in Deane's gelatine medium that I corrected myself on this point, and was satisfied that it really does possess two; so difficult is it to detect these organs in the living creature. Even in Obisium, where the eyes are four, and are situated in pairs, one behind the other, at the sides of the head, the observer is very liable to overlook them.

The falces in both genera consist of two powerful hooked mandibles, which are the weapons with which the prey is killed. Between them there may be noticed one or two comb-like structures whose office it is to clean the hairs on the pincers after a meal. Their exact form and the mode of their attachment, I have not been able to ascertain with certainty, but I shall have to revert to this subject presently. The falces in Chelifer are not so conspicuous as in Obisium, but they are used with great effect on the captured prey, and the nippers of the former far exceed those of Obisium in size and strength. Woe betide the luckless insect that invades the seclusion of the Chelifer, and falls into the grasp of those cruel, scorpion-like claws.

Immediately on being dropped into a cell, the newly captured Chelifer will search every part of it, his nippers extended in front of him, and having ascertained that there are no means of exit, and that there are no intruders, if there be a snug little corner anywhere he will take possession of it. There he sits for hours, occasionally lubricating (or perhaps cleansing) the ends of his pincers by passing them through the falces, but in no other respect betraying any sign of life. Should a few Poduræ meanwhile be introduced into the cell, he will show he is aware of the fact by reaching out at them whenever they pass near his sanctum. If hungry, he will follow slowly, and poke his nippers in all directions, in the hope of a

capture. These proceedings lead one to think his sight is none of the best in broad daylight, or under the luminous beam from the lamp. Sometimes he seems to detect their approach very quickly, and at other times he will not discover their presence till he has stumbled over them, and their terrified hurry to escape has put him on the *qui vive* when it is too late. If he should seize the Podura by a leg, or one of its antennæ, the frightened insect leaps away minus the member—a very common occurrence—but if his grip is better placed, say at the head or body, escape is impossible, and the powerful claw quickly transfers the creature to the falces, which do not let go again till the meal is finished, that is, till all the fluids are sucked away.

Should the Chelifer, in these foraging expeditions, meet one of his own kind, he immediately prepares for battle and displays considerable pugnacity and skill. Two Chelifers meeting, invariably try to seize each other's claws, and in default of this, shake their own in a menacing and ludicrous manner. If they are unequally matched, the weaker one is pulled closer and closer, till the embrace becomes deadly, and then the victor makes a meal of him; but I have sometimes seen a couple of well matched combatants both retire exhausted from the contest to their respective corners. It is not unfrequent to see one Chelifer shewing fight to another, whilst a dying Podura is quivering in the cruel grasp of its falces, just like a mouse in the jaws of a cat.

I have enclosed various larvæ and small insects with the Chelifer, and always found the intrusion of one of these into its privacy was resented by an attack on the invader, sometimes ending in its death. Generally, however, one touch of the formidable nipper was a sufficient hint to the trespasser to beat a hasty retreat.

One specimen in my possession has constructed for itself a snug little home, consisting of a silken bag, into which he often retires. He generally, however, sits in the entrance, and only withdraws from observation when disturbed. Sometimes he goes abroad and walks round the cell, but he invariably goes back to his own corner afterwards. I noticed this peculiarity with some surprise, for I did not expect a Chelifer could spin any web, and I am uncertain that he has not availed himself of something previously in the cell suitable to his purpose. The texture of the cell is very like the web made by the house spider.

One of the most curious points in the history of the Chelifer

relates to the manner in which its young are produced. In the months of June and July, I noticed that several of the most healthy specimens were disfigured by the appearance of a light yellow wart or protuberance (just like a bud) under the abdomen, and close to the junction of the fourth pair of legs with the body. This increased in size, and in about a fortnight from its first appearance, during which time it had spread out beyond the diameter of the Chelifer's abdomen, and seriously incommoded the movements of the creature, it dropped off, and I then could distinguish in the irregularities of its surface the rudimentary forms of about a dozen young Chelifers, which were contained in it. I failed to trace the perfect developement of the young, though I tried six or seven times. Twice I had great hopes of success; but in one of these instances, an adult Chelifer was discovered making his breakfast off the bunch of young ones, and in the other, a detachment of cheese-mites, which had, unknown to me, taken possession of the cell containing the interesting object, plied their mandibles with great effect, though the result was attained more slowly than in the former case.

By the way, these little Acari will take refuge in most out-of-the-way places, and remain there without food (provided they are not dried up) for a very long time—months even—but immediately anything eatable presents itself, they come out of their hiding places, a veritable horde of assassins. Were our unaided vision microscopic, probably we should often find, when and where we least expect to do so, a concealed family of these Acari waiting for a turn in their fortunes, which they know too well how to avail themselves of when it occurs. That these were cheese-mites, I am quite certain, for I traced whence they all came, and have had plenty of experience that cheese-mites will eat other substances besides cheese; they are even capable of attacking other Acari. But I return to my subject, leaving this one to a future opportunity.

My other failures in breeding Chelifers arose from my not having been successful in perfectly imitating their natural condition; but I intend pursuing the enquiry when the circumstances are favourable.

The habits of Obisium may be said not to differ from those of the Chelifer, after making allowances for its not being so well defended by a hard shell and formidable weapons as that creature is. Its weakness in these respects, and in point of size, leads to a display of greater caution and somewhat less pugnacity than is

exhibited by the Chelifer. It is often seen to take fright and run away from a lively, though perfectly harmless fellow captive: and in doing so it retreats hastily backwards, as if aware how defenceless its abdomen is in case of an attack on that quarter. The imprisonment of an Obisium with a Chelifer has always, in my experience, proved fatal to it. Sooner or later, it came within reach of the Chelifer's claws, and yielded up its life to the grim tyrant. Perhaps it does not deserve much pity, however, under the circumstances, for its treatment of young Poduræ is exactly similar to that which it receives at the claws of its relation. I think it finds the adult Poduræ too active and too large to be conveniently despatched, so it lets them alone, confining its attentions to the very small ones, and to the Acari frequenting damp places, the former insect being its staple food.

In one specimen I have been able, though in other respects it is very badly mounted, to get a glimpse of the structure of the sucking apparatus. The mouth is a considerable-sized chamber. Its exterior opening is rather small, but the entrance to the gullet is furnished with an organ which acts like the piston and valves of a pump, to convey the fluids of the wounded Podura, held by the falces at the entrance of the mouth, into the interior economy of the Obisium.

The Obisium chooses for its home a damp and dark situation, well sheltered from cold. Usually, in warm weather, it takes up its residence under a board or an old flower pot, but on cold days a search in such localities is fruitless. I have, on these occasions, had to seek it a foot or so deep in the rubbish where I get them, and even then seldom with success, for it retires to the warmest place it can find. When there is a dry cold wind, and during the months of November, December, and January, it is particularly scarce. My friend at Theale has been very successful in finding this creature. Beneath boards and old castaway bungs of casks, in one of his cellars, he frequently makes a capture, and says these localities are favourite places of resort for the species.

I have not yet had an opportunity of comparing the developement of the young with that of the juvenile Chelifers, for the difficulty of keeping specimens of either genus alive, in confinement, for a few days, is even greater than that of finding them at first.

The name "Book Scorpions" is applied to these creatures somewhat vaguely in the "Micrographic Dictionary." I say vaguely,

because it is by no means clear which genus is meant. We are told there, however, that Pseudo-Scorpions breathe by means of tracheæ. These are seen in Obisium without difficulty, if the medium in which the creature is immersed be glycerine.

In Wood's "Natural History," a few lines are devoted to Pseudo-Scorpions. He says, vol. III., page 680:—"On the same illustration with the Galeodes, is seen a magnified representation of the curious Chelifer, a little arachnoid, very much resembling a tiny scorpion without a tail. The body is flattened, and the palpi are much elongated, and furnished with a regular claw at the end, like that of a true scorpion. The Chelifer is an active little being, running with much speed, and directing its course backward, forward, or sidewise, with equal ease. It lives in dark places in houses, between books in libraries, and similar localities, preferring those, however, that are rather damp. It does no harm, however, to the books, but rather confers a favour on their owners, feeding on wood lice, mites, and other beings that work sad mischief in a library. Its general colour is a brownish red, and it is remarkable that the palpi are twice as long as the whole body. This, as well as an allied genus called Obisium, is found in England. The two genera can be easily distinguished by the cephalothorax; that of Chelifer being parted by a cross groove, and that of Obisium being entire."

In Mrs. Lane Clarke's book—"Objects for the Microscope"*—Chelifer is treated of in the chapter on Parasites, but her remarks apply to some species that attacks flies—probably the creature alluded to and figured by Mr. Bailey in "Science Gossip," vol. I., page 227, and which was afterwards named as *Chelifer Cancroides* (page 228).

Within the last fortnight, I found under an earthenware pan a creature which at first I took to be an Obisium of unusual size. It had a similar elongated body, and very large falces, but further examination showed that it possessed two conspicuous eyes and the nippers of a Chelifer, and its cephalothorax was divided by a cross groove, like a Chelifer; consequently it must be regarded as such, and not an Obisium. It differed considerably, however, from the Chelifers from Theale, being much longer in the body, and the curious compound bristles which that species possesses are here

* A descriptive catalogue of the most Instructive and Beautiful objects for the Microscope, by L. Lane Clarke. Routledge and Co., London.

replaced by ordinary simple hairs. The size of the falces enabled me to examine them minutely, and I find that each mandible is furnished with a comb-like fringe, free at the outer extremity, but attached to the mandible at the other, and lying along the side of it. Probably the structure of the falces in the other two Pseudo-Scorpions resembles that in the species I am alluding to, but I have experienced great difficulty in examining those organs, and in mounting the creatures permanently I have been quite beaten. The ordinary process, by means of balsam, seems to me to alter the general character too much, besides obliterating the more delicate structures; and glycerine, Deane's gelatine medium, and simple salt and water, cause the softer portions to shrink so much as to disguise the true character almost in an equal degree.

After the usual vote of thanks to the author of the above paper, Mr. M. C. Cooke spoke on the subject as follows:—

MR. M. C. COOKE—I am sure that we have all been much interested in Mr. McIntire's paper, and thank him for bringing before us a subject like the present, about which so little is known. As far as my own experience extends, there are, I believe, fifty-four species of Chelifers already described, and the majority figured. Of these I took the opportunity of ascertaining a few facts to lay before the Club, as a kind of appendix to the paper we have just listened to. Out of the fifty-four species named, thirty-nine are European, one belongs to the Asiatic Islands, none to continental Asia, three to North America, four to South America, and seven to Africa. Thus the old world has forty-seven, and the new world seven. Of the European species nine are found in Great Britain, and, as far as at present ascertained, three of these are peculiar to the British Islands. Linnæus would appear to have been acquainted with only two species, which he calls *Phalangium cancroides*, and *Phalangium acaroides*. In this country they have received but little attention. Except Leach, no British Zoologist has studied them. It is true that in the early volumes of Loudon's Magazine of Natural History occur several communications to the editor, concerning certain curious little creatures found attached to flies (vols. iii., iv., and vii.), which ultimately are declared to be Chelifers; and amongst these writers of forty years ago *all* are

called *Chelifer cancroides*, which appears to be a kind of "stock" name for any Chelifer. One is figured in Hooke's Micrographia (pl. xxiii., fig. 2), in Albin's Spiders (pl. xxxvi., fig. 181), in Shaw's Miscellany, and in Donovan's British Insects (pl. 215). The best figure of *Chelifer cancroides* is in the old German work of Roesel, who regarded it as a scorpion. The learned De Geer instituted the genus *Chelifer*, but it was left for our own countryman, Leach, to point out the distinction in the eyes and to separate the creatures into two genera, under the names of *Chelifer* and *Obisium*. In his "Miscellany" Leach figures and describes eight species as British, which, with the typical *Chelifer cancroides*, are all that we yet know as inhabiting these islands, for nothing has been added since Dr. Leach's time, so there is a good field for investigation, and we hope that Mr. McIntire will follow it. For the benefit of those who may be desirous of making Chelifers their study, I may add that they will find the necessary information in Walckenaer's Apteres (vols. iii. and iv.), Koch's Crustaceen and Myriapodeen (with figures), Hahn and Koch's "Die Arachniden" (vol. x.), and the 27th volume of the first series of the Annales des Sciences Naturelles. The majority of species will be found figured in these works. It cannot be too often impressed upon young microscopists how essential it is that objects should be correctly and fully named. The leg of a spider, the wing case of a beetle, or the tongue of a fly, should not find a place in any sane person's cabinet, unless what spider, what beetle, or what fly has been first ascertained.

On a New Low-Power Object Glass for the Microscope. By John Bockett.

(*Read Nov. 22nd*, 1867.)

It is only recently that our first-class opticians, after surmounting the almost insuperable difficulties attending the manufacture of the highest powers in connection with the microscope, have, as it were, now turned their attention to the construction of compound glasses of low angular aperture, but still possessing the great desideratum, absolute sharpness. It is very desirable to possess lenses capable of resolving certain objects into striæ and dots; but with due regard to the skill of the manufacturer, and the ability of the manipulator of the microscope, the bulk of real work is always done with medium and low powers. The plan adopted in Germany, as seen in their wonderfully illustrated books on Botany, &c., deservedly ought to be followed: they delineate the object as absolutely seen, and then proceed to show its structure and parts, as magnified with various powers. Let us, therefore, begin with the whole, and then analyse it with our high powers. That all who use the instrument will assert that this is the plan in vogue, I am prepared to admit; but it is to be feared that in the first place we begin our story in the middle, and not at the beginning, and, in fact, with good excuse: inasmuch, as a complete set of good objectives costs a very large sum of money. Hitherto the range of low powers for the microscope has been somewhat limited, the 2-inch, as a rule, in connection with 1-inch and two-thirds of an inch, being the general standard; the 3-inch is of modern date, but has been found to be an invaluable glass. Although the 3-inch, with the first eye-piece, magnifies only 12 or 13 diameters, it still became necessary to have an objective even of lower power than this—say, of 8 or 9 diameters—so that the whole of a beetle, flower, shell, or large section of wood, could be seen in its entirety. This desideratum has just been produced by Mr. Ross, of Wigmore Street, Cavendish Square, and is termed by that eminent optician a 4-inch object glass. It may be argued by some that a lens of such low power is really of very little use, and, in point of fact, very little needed, seeing that a hand-glass, or pocket magnifier, will enable a general view to be obtained of all moderately sized objects.

When, however, this statement is considered carefully, it will be seen that it requires very little refutation. No hand-glass of simple construction can give that definition and freedom from distortion which a lens constructed upon the usual principle upon which microscope objectives are made affords. With the former, both hands are occupied; to say nothing of the unsteadiness, it is also impossible that the illumination of the object can be perfect, added to which the non-achromaticity and spherical aberration exercises anything but a good effect upon the eyes; neither can the polariscope be used, nor can we obtain the effect of dark ground illumination. To sum all up, the observer simply makes the best use of a makeshift instrument, and is compelled, to a certain degree, to guess at details he never could have seen. On the other hand, with the new glass we have the sharpest definition; it is, of course, attached to the ordinary instrument, and has, therefore a solid stand, free from all tremor. The illumination, whether for opaque or transparent objects, is completely under control; it is achromatic, and peculiarly adapted for the binocular; and its applicability to Botany, Mineralogy, and Natural History, &c., &c., cannot be questioned. It certainly requires a very long bar, on account of its focus; but the difficulty is easily overcome, by adapting to the top of the bar a lengthening piece, which is not unsightly, soon fitted, and inexpensive. Upon bringing the glass to bear upon all the tests alluded to by Dr. Carpenter (page 192 of his last edition of the Revelations of the Microscope) specially pointed out for low power objectives, one and all are beautifully shown. For Aquaria, owing to its depth of focus, it is possible to see through a considerable thickness of water, and as small tanks, if not of considerable size, can now be made available, doubtless the study both of animalcules and minute vegetation will be much enhanced. I will only add that the recent small travelling microscopes take the power without any alteration. The amplification, with the various eye-pieces, will be found as under:—

With the A, 9; B, 15; C, 26; D, 42; E, 64; F, 86.

Some of the new glasses are on the tables, so as to afford the members of our Club every opportunity of judging for themselves.

RECOLLECTIONS OF OUR MEETINGS.

Microscopic Photography.—The subject of microscopic delineation is one which has more or less occupied the attention of every one who has used the microscope for observation. We have often envied the facility with which some observers can delineate so vividly what they see, and when reading a communication on any branch of our science, we instinctively turn to the illustrations (if there be any) as often affording a readier means of arriving at what the author of the papers desires to convey than his written words. And especially the medical student, in his investigation of animal structure in health and disease, often desires to preserve for future study and comparison something which shall be a true and faithful representation of that which he sees upon the stage of his microscope. If clever in the use of the pencil he straightway, with some expenditure of time and trouble, produces a sketch of more or less accuracy, and preserves it, either for reference or publication. But still, clever though the artist may be, careful though may be the observation, and apparently truthful the outline and details, there is still some doubt whether the draughtsman has not drawn more or less than exists in fact; and it is by no means improbable that subsequent observers may fail even to recognise the likeness to the particular object or structure of which it professes to be a representation. Many engravings in our published works are difficult to recognise, and it is a matter of interest in microscopic circles to seek for specimens which shall be similar in appearance to a certain wood-cut or engraving in some particular work. But if the object could be made to delineate itself, if the various details could be made to impress themselves permanently on some medium which could be examined at leisure and preserved indefinitely, a great deal of uncertainty and erroneous generalisation might be avoided.

Every one who has dabbled in photography, and at the same time possesses a microscope, must at some time or other have been impressed with the extreme suitability of the process for producing precisely what was wanted in the delineation of minute objects. Pictures can be produced by this process so extremely minute in

detail as absolutely to require a hard surface and the use of a magnifying power to bring them out properly. Many have experimented in this direction, but foremost amongst them all must be reckoned Dr. Maddox, whose exquisite photographs of microscopic objects have far surpassed anything that has been published in Europe. Dr. Maddox favoured us with a visit at one of our recent meetings, and exhibited there some of his latest productions, which were most admirable, both in pictorial effect and faithful representation. Some of these pictures were of the markings on diatoms, such as *Pleurosigma Formosum* and *P. Angulatum* magnified 3,000 diameters, and were exhibited as tending to solve the question as to whether they are in relief or not. For this purpose Dr. Maddox views them stereoscopically, when most certainly this effect of relief *is* produced. Some stereo-photographs of Pleurosigma Formosum exhibited by him, when placed under the stereoscope, showed the dots as hemispheres standing in closer proximity to the eye than the surface of the frustule upon which they appeared to be set; in fact, presenting the appearance of so many minute ivory balls. Attention was also drawn to the fact that some of the diatomaceous discs, when viewed stereoscopically, are seen to be composed of two surfaces, an outer and an inner one, with a certain amount of structure between them. Mr. Bockett drew attention to an experiment of Mr. Beck's, in which that gentleman photographed a portion of a glass tumbler, on which the pattern was produced by hemispherical protuberances "like so many plano-convex lenses on a convex surface," in which photographs there was a tendency to exhibit these hemispheres as hexagonals, according as their tops or bases were focussed by the lens.

We very much fear, however, that the stereoscopic test is hardly reliable. Very considerable apparent modifications of form are produced by varying the condition of binocular vision. Apart from the fact that if you change the pictures from one side to the other you will find the relief become depression, and *vice-versâ*, it will be observed that if a perfectly flat picture be examined by a pair of short focussed stereoscopic lenses it will appear to stand up precisely like the field of a binocular microscope. Take a negative of a black disc for instance, and print two copies of it either on glass or paper, place the two side by side in a stereoscope, and although pictures of a flat surface the effect will be that of a convex one.

Apart from these considerations altogether, there can be no doubt

that Dr. Maddox deserves well of the scientific world for his arduous labours in delineating minute forms. Many of his beautiful productions may yet be seen at Mr. How's, Foster Lane, Cheapside, although we very much regret to say that, considered commercially, they have not met with the success which they merit. More than this, after seven years' labour in one direction this zealous worker finds his sight is injured, and for want of the successful publication of his works is compelled to give up the further pursuit of his experiments, without having realised that pecuniary reward which his unwearied efforts so eminently deserve.

QUEKETT MICROSCOPICAL CLUB.

OCTOBER 25TH, 1867.

ARTHUR E. DURHAM, ESQ., PRESIDENT, IN THE CHAIR.

The minutes of the preceding meeting were read and approved.

The Secretary announced the following donations to the Club:—

"The Popular Science Review," from the publisher; "Science Gossip," from the editor; Hogg "On the Microscope," new edition, by W. Curties; and the "Naturalists' Circular," from the editor.

The thanks of the members were ordered to be communicated to the respective donors.

The following gentlemen, were proposed for membership in the usual form:—Mr. John Sandford, Mr. Wm. Henry Golding, Mr. R. Williams, Mr. Francis W. Blake, Mr. A. F. Tarner, Mr. Frank H. Ward.

The names of the nine gentlemen proposed at the previous meeting were then balloted for, and they were declared duly elected members of the Club.

The President announced that the Committee had decided on publishing the proceedings of the Club quarterly, under the editorship of Mr. W. Hislop. A copy would be forwarded free to each member.

Mr W. W. Reeves asked those gentlemen who had taken part in the excursions of the Club during the summer to send in a list of things which they had seen and collected, in order that a record of them might be kept. Members who knew of good stations for collecting, would also greatly assist

the excursion committee if they would send them a list of such places for the sake of varying and extending the field of research.

Mr. McIntire read a paper "On Pseudo-scorpiones." See page 8.

The Secretary read a paper by Mr. Charles Nicholson, M.A., of Edinburgh, "On Object Glasses for the Microscope."

The object of the writer was chiefly to point out the desirability of limiting the number contained in a set of object glasses as much as possible, and at the same time to obtain the necessary magnifying powers with the first and second eye-pieces. He endeavoured to show that eight powers would "span" the whole present power of the microscope by the following table. Eye-piece A is taken as having a magnifying power of 5; B, of $7\frac{1}{2}$; C, 10; D, $12\frac{1}{2}$; and E, 15.

Object Glass No.	Focus in 100ths of an inch.	Nearest made.	A	B	C	D	E
1	2.56	2 or 3 inch	18	28	37	56	75
2	1-28	$1\frac{1}{2}$ or 1 inch	37	56	75	112	150
3	.64	2-3rds	75	112	150	225	300
4	.32	4-10ths	150	225	300	450	600
5	.16	1-6th	300	450	600	900	1250
6	.08	1-12th	600	900	1250	1850	2500
7	-04	1-25th	1250	1850	2500	3750	5000
8	.02	1-50th	2500	3700	5000	7500	10000

The President announced that lists were open for the receipt of the names of members desirous of joining the three classes, namely, Mr. Suffolk's for Microscopic Manipulation, Mr. Cooke's for studying Microscopic Fungi, and Dr. Braithwaite's for studying the Mosses.

It was announced that at the next meeting Mr. Burgess would read the first of two papers on "Wools, microscopically and commercially considered."

NOV. 22ND, 1867.

ARTHUR E. DURHAM, ESQ., PRESIDENT, IN THE CHAIR.

The minutes of the preceding meeting were read and signed by the Chairman.

The Secretary announced the following donations to the club:—Two slides from Mr. McIntire; five slides from Mr. Geo. Potter; one slide from Mr. Moginie; a large engraving of Daphnia Pulex from Mr. Curties; the "Naturalists' Circular," from the Editor; "Science Gossip," from the publisher; and the last new edition of "How to work with the Microscope," from Dr. Beale.

The thanks of the members were ordered to be presented to the respective donors.

The following names of gentlemen proposed for membership were read by

the Secretary .—Mr. Henry Symons, Mr. John W. Bailey, Mr. Charles S. Bentley, Mr. Alfred Martinelli, Mr. George F. Smith, Dr. Adam Bealy, Mr. H. B. Preston, Mr. Charles E. Osborne, Mr. Edward T. Draper, Mr. William C. Chapman, Mr. Frederick Oxley.

The names of the eight new members proposed at the last meeting, were then balloted for, and they were declared duly elected.

Mr. Burgess then read the first part of a paper entitled "Wools, commercially and Microscopically considered." (See the next number). The paper was illustrated by a large collection of samples of wool, both in its natural state and manufactured.

The thanks of the meeting were presented to Mr. Burgess, for the first part of his paper.

Mr. Bockett then read a paper "On a new low power object glass." (See page 16), for the purpose of introducing a new 4-inch objective by Mr. Thomas Ross. The performance of the instrument was exemplified on a variety of objects by means of several microscopes, and was pronounced by all observers to be highly satisfactory.

The president having announced that at the next meeting Mr. Burgess would take up the Microscopic portion of his dissertation on Wools,

The proceedings terminated.

Rock Sections for the Microscope.—The rock sections may be prepared for the microscope as follows :—A fragment, from a quarter to three-quarters of an inch square, and of convenient thickness, is chipped off the rock specimen in the direction of the required section, and ground down upon an iron or pewter plate in a lapidary's lathe with emery, until a perfectly flat surface is obtained. This surface is then worked down still finer by hand on a slab of black marble with less coarse emery, then upon a Water of Ayr stone with water alone, and lastly finished by hand with water on a slab of black marble. By these means the surface acquires a sufficient polish without being contaminated with rouge or other polishing powder or oil, as is sometimes the case with purchased sections of rocks. This side of the rock is now cemented by Canada Balsam to a small piece of plate glass about 1½ inch square and ⅜ in. thick, which serves as a handle when grinding the other side of the emery plate as before ; this grinding is continued until the section is so thin as to be in danger of breaking up from the roughness of the motion, upon which it is completed by further grinding with emery by hand on marble, and finished first upon Water of Ayr stone with water, and afterwards upon black marble as above described. The section is now removed from the plate glass and mounted in Canada Balsam on a slide, covering its upper surface with thin glass as usual. The thickness to which such sections need be reduced is, of course, entirely dependent upon the transparency of the rock constituents, and is commonly from 1-100th to 1-1000th of an inch. Thin splinters of rock and powdered fragments mounted in Canada Balsam may also be examined with advantage, but cannot replace the above described sections.—*Popular Science Review.*

THE JOURNAL

OF THE

Quekett Microscopical Club.

The Wools of Commerce Commercially and Microscopically Considered. By N. Burgess.

(*Read November 22nd, and December 27th*, 1867.)

[Abstract.]

Part I.

The first part of the paper was limited to the commercial aspect of wool. True wool was stated to be confined to the several varieties of sheep; and the subject was divided as follows:—Geographical Distribution of Sheep;—Varieties of Breed;—Rise and Progress of Australia the Cape of Good Hope, Natal, and the River Plate, as wool producing colonies;—an analysis of the varieties of fleece produced in Great Britain, and an account of the method of converting wool into cloth. It was illustrated by seventy-nine specimens of special character, together with samples in various stages of manufacture.

Part II.

In the first part of this paper attention was called to many facts relating to wools from various breeds of the animal which produces that material. It was stated that all the non-divergent forms of sheep might have had one common origin, and therefore that all the wools would have essentially the same primary structure, which would be more or less modified where climate or soil have produced alterations in the fibre. The microscope shews us that an apparently solid hair is not really so. In a transverse section of that of the elephant, for instance, it is apparent at once that the hair, like a section of a tree, has internal perforations, in which probably similar functions in life are carried on. In a section of the human hair we have a form which some have described as a hollow tube, resembling a quill or straw, the interior being altogether hollow;

but if put under polarized light it will be seen that the internal part is filled with a granular material, which occupies the whole of the inside, with the exception of the extreme centre, where a sort of central pith is just observable, probably intended to be a channel to admit supplies of nourishment, or coloring matter to sustain it in a state of health. I am of opinion that this will be the rule in all kinds of hair, and that each genera of animals will have its own peculiar form, both internally and externally.

In the year 1664, the learned Dr. Hooke brought before the Royal Society a paper upon hairs, and in the "Micrographia," published two years afterwards, are several figures of hairs in section. He combats the idea that hairs were hollow, but seems to fall into as great an error on the other side by concluding that hairs were mostly solid. Hooke's figures are good on the whole, and have been often copied in this country, and on the continent. About thirty years after this, Leeuwenhoek took up the subject of hair and wool, and in his select works are to be found figures of human hair and of wool; but his figures of wool are very bad, and prove that he had no knowledge of its microscopic form.

Henry Baker, F.R.S., in the year 1742, read a short paper on hairs before the Royal Society. In his books, published in 1744, he devotes two pages to the subject; but he classes human hair with that of horses, sheep, and hogs, and describes it as composed of long tubular fibres, or smaller hairs, encompassed with a rind, or bark; but separates the quills of the porcupine or hedgehog from this class, as containing a whitish pith, in a star-like form.

We may conclude that a microscopic investigation of wool belongs to the present century, and the results which have been published are not accurate; neither Dr. Quekett, Dr. Beale, Dr. Carpenter, or Dr. Jabez Hogg allude to the subject.

Dr. Wythes, in a work called "The Microscopist," published in Philadelphia, takes up the prevailing notion that the imbricated scales on the external surface of each fibre are the cause of wool possessing its well-known felting property. In the "Penny Cyclopædia," under "Sheep," Vol. XXI., p. 356, is a very good article on wool and sheep; but the writer has fallen into the same mistake as to the "felting process."

After speaking of the "elasticity," or yielding character of the wool, and of its "pliability" and "softness," "without which no manufacture of it can be carried to any degree of perfection," he

alludes to its "felting" property. He states that "the fibre, examined under a powerful microscope, appears like a continuous vegetable growth, from which there are spronting, and all tending one way from the root to the other extremity, numerous leaves, assuming the appearance of calices or cups, and each terminating in a sharp point. It is easy to conceive how readily one of these fibres will move in a direction from the root to the point, while its retraction must be exceedingly difficult, if not impossible. It was a fibre of merino wool that was first submitted to microscopic observation, and the number of these serrations or projections counted. There were 2,400 in the space of an inch. A fibre of *Saxon* * wool, finer than that of the merino, and of acknowledged superior felting quality, was substituted. There were 2,720 serrations." Southdown is stated to have 2,080, and Leicester wool of less felting property, 1,860 serrations in the inch.

The writer further states "There can be no doubt as to the structure of the woolly fibre. It consists of a central stem, or stalk; from these spring at different distances circles of leaf-shaped projections, possessing a certain degree of resistance, or of entanglement with other fibres, in proportion as these circles are multiplied, and they project from the stalk. They are sharper and more numerous in the 'felting' wools, and in proportion as the 'felting' property exists. They are connected with, or it may be confidently asserted they give to the wool the power of 'felting,' and regulate the degree in which that power is possessed."

P. H. Gosse, in his "Evenings at the Microscope," gives a description of wool similar to the above.

The Hon. Mrs. Ward gives a fair illustration of wool, and shews no serrations on the edge.

Dr. Lankester, in his "Uses of Animals," treats of the subject, but admits his ignorance of technical terms. The term "picked tegg," which he does not understand, refers to a fine kind, also called "picklock," sorted out of a tegg fleece, a "tegg" fleece being the first fleece of mature growth cut from a sheep not previously shorn. In his figures of wool, Nos. 7, 8, 9, and 15, Dr. Lankester gives illustrations of Spanish merino, Southdown, Leicester, and finest Spanish, which are very well done, but do not throw any light on the subject. There is no scale of magnification given, and

* *Saxon* wool is now the only known living type of the original merino sheep of Spain.

the letter-press cannot be reconciled with the engravings. Fig. 16 is said to be East Indian wool, but is not correct, the representation being that of "Kemp" hair, which, although taken from the same animal, is not fine wool, but a coarser, longer fibre which often overlies the softer and more valuable wool.

Mr. Youatt's work on "The Sheep" is that of a man who is evidently well posted in his subject; and I can almost suppose that the article in the "Penny Cyclopædia," already quoted, was written by the same person. Mr. Youatt considers himself to have been the first to discover the serrations on the edge of the wool fibre, and hence to have been the discoverer of the true secret of the felting property which wool possesses. He tells us that on the 7th of February, 1835, he, in company with five gentlemen, of whom Mr. Powell, the optician, was one, first obtained a view of the hitherto supposed serrations on the edge of the wool fibre, and was the first to make that fact known to the world. He also expresses the opinion that this serrated edge, together with the curly nature of the fibre, produce the "felting property of the wool." He then gives a series of drawings of twenty-four kinds seen as opaque objects, and twenty-seven by transmitted light.

But I object to the serration theory most emphatically, and I cannot believe that in one instance out of the fifty-one figures the object is faithfully drawn. I cannot account for this want of truthfulness in the figures; but I leave the members to compare nine of Mr. Youatt's figures, copied on a large scale, with the fibre itself as seen under the microscope. Notwithstanding this deficiency in the microscopic part of the work, I believe it to be the best on sheep and wool ever published in any country.

The result of this examination of the literature of the subject is unsatisfactory, but to the first president of the Quekett Microscopic Club belongs the credit of the best figure of sheep's wool yet published.

To the Hon. Mrs. Ward and Mr. P. H. Gosse I must award the second place. Mrs. Ward's figure is too regular and cylindrical in appearance; but the scales are most correct. Mr. Gosse gives the irregular outline of the edge much better, but fails in accuracy in the imbricate form of the scales.

I propose to deal with the fibres of wool under three different heads—first, its ordinary form of growth; secondly, its external form and structure; thirdly, its internal structure.

First. Its ordinary form of growth. The quality of the wool varies very much in different parts of the same animal. In a sheep of pure Merino breed the back presents a close, dense mass. If a small portion of this be carefully cut off next the skin, it will appear like the samples in the case labelled "Saxon wool." If this be carefully examined, it will be seen to possess a large number of curves arranges in symmetrical order, from the root to the apex of the staple.

The finest wool in the unwashed condition (or in "the grease"), has 30 of these curves to the inch; the others, most of which are from rams, have 23 or 24, and the curves are very close and uniform in their arrangement. Among the samples of "Wools of Great Britain" is one from a Southdown wether fleece. In this there are but thirteen curves to the inch, and the fibre is much coarser; the Saxon being $\frac{1}{1562}$ of an inch, and the Southdown $\frac{1}{700}$ of an inch in diameter. A "tegg" or "hoggett" of Southdown breed is still coarser, giving 11 curves to the inch. Lower again in the quality and number of curves is the Irish hogg wool, with only six curves to the inch, while the Lincoln gives but two curves in the same space, and lowest of all is the Northumberland, with two curves in one inch and a quarter.

If, now, a fibre be taken from the Merino and another from the Lincoln, and be laid side by side, the relative proportion of their curves will be as 15 to 1. If a number of these fibres were taken, each sort separate, it would be seen that the amount of entanglement between the fibres would be 15 times greater in one case than in the other. Suppose that instead of their natural form they are laid parallel to each other in a straight line by machinery, each fibre has a natural tendency to regain its original position. Suppose the now parallel fibres are twisted into a yarn and then woven, and the warp is strained tight in the loom, many of the loose threads having been stuck down in the sizing process, it is evident that in this condition all the fibres are in a state of unnatural tension until they come out of the loom in the form of cloth.

All external tension is now removed in order for the next or "felting" process; the loose fibres being released, the cloth being saturated with moisture, the whole has to undergo a process cf heavy thumping, during which each fibre has a pressure applied, first in one place, then in another. I believe that each fibre at

every stroke is doing its utmost to regain the curved condition; and as it does so the cloth contracts and becomes thicker. This thickening is in proportion as the fibres of the wool have resumed their curved form from the temporary parallel condition. This, and this alone, in my opinion, is the true cause of the felting process. I am prepared at any time to say whether a wool will or will not felt, without the use of the microscope and the tedious process of counting the serrations.

It is well known to our cloth manufacturers that "skin" wool, or wool cut after death, felts better than if cut from a living animal. Some may ask how is that to be accounted for? I answer that in death some parts of the animal are distended and others contracted, and this alteration being communicated to the fibrous covering, there would be more room for the contraction of the fibres in the process of manufacture than in those taken off while in the living state. "Skin" wool is sometimes taken off with lime, or sometimes by causing an incipient state of decomposition, when the wool separates from the skin; but other causes are at work which are not here discussed.

Lord Somerville considered the "yolk," which is an animal secretion of a greasy nature, to be the cause of "felting" being much found in Spanish Merinos. "Yolk" and the curves I have described, always go together. The pure Merinos contain a large amount of "yolk," as well as many curves, but the "yolk" is washed out, while the curves remain.

But as to serrations: I object to the word "serra," a saw; there is no resemblance to the teeth of a saw. "Imbricated" is another term, which is probably as good as you can get, meaning a something which overlaps something else. Mr. Youatt thinks that these so-called serrations act with the curves in producing "felting," while others attribute all the "felting" to these teeth! Now, if these "teeth" do this work, or do about an equal part of it, what is their action? The "teeth" could not produce "felting" if all were lying in the same direction; they would produce just the contrary effect. Let us suppose that through the whole fabric every other fibre was lying in an opposite direction to its neighbour, and the "teeth" entangled in contrary directions. The result would be the opposite of that supposed, for each fibre would pull in contrary directions. For illustration: suppose a railway train has an engine of equal power at each end, and both pulling the opposite

way, with equal force, the train would be stationary, but every carriage in it would be as wide apart as possible—the very opposite of the principle of "felting," which is drawing or bending together. My curve theory is like putting the two engines to push the train along, and to close the carriages together.

The second point is the external form and structure of the wool.

The form is difficult to describe, being similar in character, but diverse in details—like the bark of a tree, having a generic form, but varying in individual species. In twenty-six different sorts, I have found no general difference, except in two samples of Sfax, or Malta wool. These were very different to all the others, and will form subjects for further examination. If the "serration" or "imbrication" dogma were correct, we should in these cases have a fibre that would felt better than any other, as they are more imbricated than any others. On the contrary, they hold about the lowest power of "felting" of any kind possessing the same quality of fibre.

In the twenty-six sorts examined I found great variation in the size or thickness of the fibres, or in the quality. The size of the fibre has a great deal to do with the imbrications upon its surface. Thus, one fibre having twice the diameter of the other, if the number of imbrications was the same in a given space on both, the coarsest would relatively possess twice the amount of imbrication in proportion to the other.

Wool generally assumes the form of a pointed fibre of a cylindrical character, of various thickness, and presenting a rough outline when viewed in profile; but the pointed fibre only belongs to the lamb or tegg, for after an animal is once shorn, the pointed form disappears. I am not aware that this particular structure has ever before been described, and it is somewhat difficult to show it, in consequence of the fibre becoming injured.

Specimens as existing in lamb's wool are shewn, and also some of East India wool exhibiting a flattened form, but whether natural or owing to pressure in packing, I cannot say.

Now, as to the nature and mode of growth of wool. In my first paper I stated that wool was distinct from hair, considered commercially, but physiologically they are identical. Our best writers agree that hair or wool is the epidermis in a state of metamorphosis, and though the form is changed, the nature of the material remains the same.

Hence hair, wool, the nails of the fingers, the claws of birds, and the horns and hoofs of animals are identical in substance. A friend of mine, while exploring the Zulu country, in Africa, found a weathered specimen of the horn of rhinoceros, which curiously illustrates this point. It was thirty inches long, and six inches in diameter at the base. The tip was so disintegrated as to resemble a tuft of bristles mixed with hairs.

I am of opinion, with respect to the growth of wool, that as soon as the point of the fibre has protruded through the skin of the animal, a series of growths takes place, a small part of the epidermis is converted into wool, and then a rest ensues. One side grows faster than another, whence probably the curly form of the fibre. When another growth takes place, another ring is added, the new growth pushing up the hair from below, and so adding to its length; this process is repeated, varying as to the length, straightness, and girth of the joints, and possibly with a variation in the thickness of the cylindrical portion of the fibre. The difference would, of course, depend on the physical condition of the animal, and the character of the food, which sometimes so acts on the fibre that a staple will break in two at a certain part, just as though it were scorched, probably through the epidermal wall being thinner at that part

These alternations of growth and rest produce that form on the external coat of the fibre, which has been so unscientifically called "serrated." These points, it must be observed, are not at right angles with the edge of the fibre, but oblique, some at one angle some at another, some confluent, others divergent, some raised above the surface, while others show scarcely any elevation at all.

Next, as to the size of fibres.

The size of the fibre is very irregular, scarcely any two from the staple being found alike, and each varying in its own length. In a fibre of Southdown wool, a comparatively uniform species, I have found the size to vary in $\frac{1}{312}$ of an inch as much as one fifth of the whole diameter.

I may here explain that the term staple refers to the small tufts, somewhat like a wheatsheaf in form, in which the wool grows on the animal.

The finest Saxon wool I have ever seen, gave a remarkable result on being measured. Five hairs in one staple were selected; the finest gave the extremely small diameter of $\frac{1}{3498}$ of an inch, or $\frac{1}{140}$ of a millimetre, while another fibre lying by its side measured the

$\frac{1}{1749}$ of an inch, or $\frac{1}{70}$ of a millimetre. The mean of the fine fibres gave $\frac{1}{2134}$ of an inch, or $\frac{1}{70}$ of a millimetre. Another sample of Saxony wool gave $\frac{1}{2075}$ of an inch, or $\frac{1}{83}$ of a millimetre. Among Saxon wools shown "in the grease," two of the fibres were measured, one being $\frac{1}{1562}$ of an inch, or $\frac{1}{62}$ of a millimetre, and the other $\frac{1}{1250}$ of an inch, or $\frac{1}{50}$ of a millimetre. Probably this sample could not be exceeded for beauty or symmetry; it was taken from one of Steizer's celebrated ewes.

The Southdown sample shown gives for one fibre $\frac{1}{890}$ of an inch, or the $\frac{1}{36}$ of a millimetre, and for another $\frac{1}{520}$ of an inch, or $\frac{1}{21}$ of a millimetre. The Lincoln wool gives for one part of the fibre $\frac{1}{625}$ of an inch, or $\frac{1}{25}$ of a millimetre; for the other $\frac{1}{520}$ of an inch, or $\frac{1}{21}$ of a millimetre, and for the coarsest $\frac{1}{446}$ or $\frac{1}{18}$ of a millimetre.

In a sample of the "Russian Douskoi," one fibre, measured in three different places, also gave the same diameters. If "imbrications" go for anything Russian Douskoi should eclipse every other in the "felting" process; but here again facts are dead against that theory.

A fibre of the Northumberland wool, measured in its thinnest part, gave $\frac{1}{666}$ of an inch, or $\frac{1}{27}$ of a millimetre; and $\frac{1}{400}$ of an inch, or $\frac{1}{16}$ of a millimetre at its thickest diameter. These examples will suffice for showing the relative degrees of size, and the varieties which occur in the same fibre.

I intended to devote the last part of this paper to the internal structure of the wool fibre, but I must leave it to another opportunity, for several reasons. It is a subject which requires time, special apparatus, and manipulative skill to work out.

I may, however, indicate that some wool fibres, which look like hollow cylinders, will probably not prove to be so; some, indeed, I find to be filled with a transparent substance having a pith-like core.

In East India wool there is, at times, a condition intermediate between the states of "Kemp" and wool, in the interior of the fibre. In the true "Kemp" this part of the fibre or pith is not pervious to the dyes used, in the same degree as the other fibres. In the Douskoi there is sometimes a change in the same hair from the wool form to the "Kemp," and the same thing has been noticed by me in the Northumberland sample of wool before you.

I had also proposed to test the action of certain chemical substances used in the manufacture. Soda ash, for instance, con-

tracts the fibre. Urine is considered the best for cleansing, and in manufacturing districts the operatives often wash their woollens and flannels in dilute urine, from its known action upon wool and woollens. The specimens prepared for the microscope have been washed in benzine, which abstracts the grease.

In my first paper I mentioned the Punjaub wild sheep in the Zoological Gardens, in reference to the two-fold growth of wool and a kind of hair besides. This hair is an interesting object under the microscope; the scales are very close together, and under some kinds of illumination are not unlike the hairs of some of the deer tribe. If "felting" depended on serration, these ought to possess amazing felting qualities; but they do not "felt," for there are no curves. This two-fold growth is found in wool from the Crimea. The fine quality is wool in every respect; the hair-like growth intermixed with it is entirely hair as to structure, some very white, and much like some of the deer. Both "Douskoi" and China wools also exhibit a tendency to two-fold growth.

On true hair-bearing animals, a two-fold growth exists, but very different to the cases cited, inasmuch as they are both of the same character. Mrs. White, sister to the late Dr. Quekett, gave me some hair from a Persian cat, one part of which was soft and long, and another part much coarser; but under the microscope the only difference was that the coarser kind was rather more opaque.

The fine fur on the vicugna of South America is much like wool, but the coarser kind is distinct in form and structure. It consists of a thick, flattened fibre, and is somewhat fluted, like the shaft of a column. The fur and hair of the Polar bear present two different appearances. The fine growth is like wool, but the markings are not so close together, and the size is uniform. The coarser growth is similar to the human hair.

I have only to add that I have not investigated the wool of the black variety of sheep, and, therefore, cannot say whether the pigment is internal or external.

I cannot close this paper without expressing my satisfaction at having done my best to explode an effete theory as to the felting properties of wool, and if my papers result in putting down one of our popular errors, my time will not have been mis-spent.

On the Hairs of Indian Bats. By M. C. Cooke.

(Read January 24th, 1868.)

For five-and-twenty years an object has been known to microscopical observers as the "Hair of Indian Bat," and during that period, if efforts have been made to discover its source, those efforts have not been crowned with success; for it is still unknown what species of bat yields the hairs which are employed as test objects. Full of hope that this species might be discovered, the investigations which led to the production of this paper were undertaken. Facilities occurred for examining the hairs of a large number of well authenticated species of Indian Cheiroptera, and the result of this examination forms the subject of the present communication.

Before proceeding with the investigation, I may be permitted to summarise what has been written on the subject, so that it may be seen how far my observations agree with those of other observers who have preceded me. Although bats' hair was known to be an interesting microscopic object thirty or forty years ago, I think that there is no special mention of the hair of an Indian bat, or of any other bat's hair wholly resembling it, until Mr. John Quekett brought the subject under the notice of the Microscopical Society of London, on the 20th October, 1841, as recorded in Cooper's Microscopical Journal (p. 158), and afterwards printed in full in the Microscopical Transactions (vol. i., p. 58).

As these "Transactions" are not common, and as the observations there made are of importance in this enquiry, I shall extract those portions to which I may hereafter allude. After describing the structure of hair in general, he says:—"Having stated thus much on the growth of hair, I shall proceed at once to the examination of that of the bat tribe. Of sixteen species of these animals, the hairs of which I have examined, all were analogous in structure to one or other of the forms represented. They are characterized by the shaft presenting at intervals peculiar raised markings, which are arranged sometimes transversely, at others obliquely, to the axis of the hair; in some specimens they project a considerable distance from the general surface, and the true shaft of the hair appears between them at certain intervals. Having, on

more than one occasion, failed in pulling the hairs out of the skin with my fingers, in order to obtain some, a knife was used, and the hair held firmly between its edge and the thumb. On examination of these hairs afterwards, it was found that they were altered in character, the markings on them, which were so peculiar, being destroyed in some parts, and left undisturbed in others; they appeared as if something had been taken away from them in certain points. This led me to expect that the curious surfaces which these hairs present might be owing to a development of scales on their exterior, and repeated examination has convinced me of the truth of this supposition I have since found that by submitting hair to a scraping process, minute scale-like bodies, tolerably constant, as far as regards their size and figure, can be procured, so that bats' hair may be said to consist of a shaft invested with scales, which are developed to a greater or less degree, and vary in the mode of their arrangement in the different species of the animal. The surface of that part of the hair nearest the bulb is nearly free from any trace of scale, but as we proceed towards the apex the scaly character becomes more evident. In many hairs the scales lie in a direction at right angles with the shaft, and one scale forms a complete band around the shaft; in others they run with varying degrees of obliquity, giving a true spiral character to the hair, whilst in many others, scales may be seen in all stages of development. The larger kind of hairs, such as are procured from the various species of vampire, are generally of a dark yellow colour, and are comparatively smooth externally, but exhibit a cellular structure internally. Many of the scales are not unlike—in shape—those from the wings of butterflies, but are much more minute, and exhibit no trace of striæ on their surfaces; but those taken from dark coloured hairs have the colouring matter deposited upon them in small patches. In some cases they appear to terminate in a pointed process, like the quill observed in butterflies' scales, and in others the free margin is serrated. By scraping, many of them will be detached separately, but in some few cases as many as four or five will be found joined together. In the larger hairs the cellular structure of the interior, as well as the fibrous character of the shaft, can be well seen when the scales have been removed.

"As far as my observations have gone, they lead me to believe that the smaller the hair is in diameter, the more closely packed are the scales; and it would account at once for some appearances

which many hairs present, if it were found that the shaft of the hair grew faster than the scales which surround it, and that the whorls of scales were separated from each other, just as the slides are in the drawing out of a telescope.

"Since these observations were made, I have been kindly favoured by Mr. Powell with some hair of a bat from India, the species of which is at present unknown, in which the view I have entertained of the nature of bats' hair is beautifully borne out, and if any doubt had previously existed of the scaly character, I think that it would at once be banished when these hairs were seen under the microscope. The scales are most remarkably developed, and in some of the hairs they surround the shaft in a continuous whorl, and without any preparation by scraping, in many places they will be found to be entirely wanting, whilst in others they are still attached to the shaft, but out of their proper position."

Dr. Carpenter, in "The Microscope," alludes to the hairs of one of the Indian species of bat in the following words: "It has a set of whorls of long narrow leaflets (so to speak) arranged at regular intervals on its stem" (p. 644, fig. 329 *c*. 1857). It will be observed that two theories of structure are indicated by these two observers. Quekett regards the whorls as entire scales or cups, with an irregular margin, in which we shall hereafter find Mr. Gosse corroborating him; whilst Dr. Carpenter alludes to them as whorls of leaflets, or (as I presume) independent linear scales, in which Griffith and Henfrey seem to concur. Figures also bear out this interpretation, for Quekett's original figures show the scales removed entire, and Carpenter's figure gives the whorled character. Dr. Hogg in his figure exhibits Dr. Carpenter's theory, and in his remarks quotes Quekett's, and thus commits himself to both. The figures given in Quekett's treatise on the microscope are very different from the original figures, and, as I believe, incorrect. I may allude to the figure given in Brewster's "Treatise on the Microscope" (1837), published before Quekett's observations of the whorled "hair of the bat genius" (pl. xii., fig. 16), which is remarkably rude, and probably does not indicate the hair of an exotic species. A similar rough figure is given in Brocklesby's "Views of the Microscopic World" (New York, 1851), "each possessing a figure like that which would be formed by a series of cones, with the points of each inserted into the middle of the base of another" (p. 126, fig. 206).

After alluding to the structure of the hair of English bats, Mr. Gosse, in his " Evenings with the Microscope," says: " Even this is far excelled by a species of bat from India. The trumpet-like cups are here very thin and transparent, but very expansive, the diameter of the lip being, in some parts of the hair, fully thrice as great as that of the stem itself. The margin of each cup appears to be undivided, but very irregularly notched and cut. In the middle portion of the hair, the cups are far more crowded than in the basal part, more brush-like, and less elegant; and this structure is continued to the very extremity, which is not drawn out to so attenuated a point as the hair of the mouse, though it is of needle-like sharpness. The trumpet-shaped scales are, it seems, liable to be removed by accident; for in these dozen hairs there are several in which we see one or more cups rubbed off, and in one the stem is destitute of them for a considerable space. The stem so denuded closely resembled the basal part of a mouse's hair in its ordinary condition" (p. 13, figs. *a b c*. 1859).

In the " Micrographic Dictionary " (pl. xxii., f. 6), is a figure with the brief remark that it is the hair of " the Indian bat, in which the scales are grouped in whorls at pretty regular intervals along the shaft, and project considerably beyond the surface " (p. 335. 1860).

In Griffiths's " Text Book for the Microscope," the author writes: " In the hairs of some of the foreign bats, the scales are whorled, forming very beautiful objects " (p. 118. 1864).

In Willkomm's " Die Wunder des Mikroskops," the figures of which are, singularly enough, identical with those in Hogg " On the Microscope," at p. 242 (fig. 144. 1856), the figure of the hair of Indian bat is given, without further remarks.

I may remark as a curiosity that, in Fonvielles' " Les Merveilles du Monde Invisible," the hair of the larva of Anthrenus is figured as the hair of a bat.

Although doubts have been very freely expressed, whether the " Hair of Indian bat " is the hair of a bat at all, I think that there is really no good ground for scepticism; indeed, the only support which I conceive that scepticism can receive will be in the production of the hair of some other animal more resembling that which is sold by Topping as " Hair of Indian bat," than any known specimens of hair derived from an undoubted bat. It must be borne in mind that the hairs which I exhibit are from animals

which have been preserved, and brushed, and dusted, and subjected to all kinds of vicissitudes for twenty or thirty years, whereby, undoubtedly, their microscopical character has suffered considerably. A fair allowance should be made for this fact, which is only counterbalanced by their specific identification.

Assuming that the hair in question was that of an Indian bat, I was led to enquire what species of bats were found in the Indian Empire, and in this enquiry I was assisted by three catalogues, which are the only authoritative ones with which I am acquainted.

I.—Dr. J. E. Gray's list of the specimens of the Mammalia in the collection of the British Museum, dated 1843.

II.—Dr. Horsfield's catalogue of the Mammalia in the Museum of the Hon. East India Company, dated 1851.

III.—Mr. Edward Blyth's catalogue of the Mammalia in the Museum of the Asiatic Society of Bengal. Calcutta, 1863.

In Dr. Gray's list occur the names of 47 species of Indian bats. In Dr. Horsfield's catalogue there are enumerated 34 species, and in Mr. Blyth's catalogue (including desiderata), 73 species. In one list some species occur which are not found in the others, and some probably which may be only varieties, but taking them as they stand, excluding all which are quoted as synonymous, and accepting those which the authors regard as distinct species, we have, on a comparison of the three lists, not less than 90 species, distributed amongst 24 genera. Inasmuch as Mr. Blyth's catalogue is the most recent, and taking into account the advantage he possessed of residence in India, and of personal examination of many living species, I am inclined to accept his list as the basis of my observations.

The 73 species named in Blyth's catalogue are grouped under 24 genera. These include Malayan and other forms not found in continental India.

The only positive information which could lead to the discovery of the unknown species was communicated to me in a private letter addressed by Mr. Janson, of Exeter, to a friend, from which I am permitted to quote.

Mr. H. Janson writes: "I have every reason to believe that I was the means of first introducing this object to the microscopic world, and thus it was—One of my immediate neighbours (now many years ago) was an old Indian officer, named Major Godfrey, who had lived twenty-five years there, and who had a strong turn

for natural history. He brought over with him an immense load of mammalia, birds, &c. I having told him that the hairs of various animals were interesting objects for the microscope, he said, 'I'll send you over a lot of them.' Accordingly he sent me a pinch from a considerable number, on examining which I found some good things, and some of not much microscopical value; but on coming to the hair of the Indian bat I was literally astounded and exclaimed that I had never seen any hair equal to that. But to describe the bat itself, which I have had in my hand; it was not larger than the common English bat, but was remarkable for the length of its tail, which was, I should think, full three inches long, and was known in India as the *long tailed bat.* I sent a specimen to Mr. Powell (long before his union with Mr. Lealand), and he said he had never seen anything like it before."

It is scarcely necessary to remind you of the structure of ordinary hair, of which human hair may be taken as an example. It consists usually of a *medulla* or central pith, surrounded by a *cortex* and enclosed in an *epidermis*, the outer cuticle of which consists of irregular transparent plates or scales. These parts will be found to present themselves in the hair of bats, subject to modifications, more particularly in the form and arrangement of the cuticular plates or scales. Although I shall follow a zoological order in the enumeration of the hairs which I have examined, I shall regard them as constituting six groups, more or less allied by structure as well as zoological affinities.

In the large frugivorous bats of the Malayan Islands and Continental India, the simplest form of hair prevails. There are four species of *Pteropus* known in these localities, of which I have only examined two. One of these is the Kalong of Java, found also in Tenasserim, and known as *Pteropus edulis*, and the other is the Wawul of the Malays *(Pteropus Edwardsii)*, which is found in India generally. The species of which I have not seen the hairs, are *Pteropus Leschenaultii*, of Southern India, and *Pteropus melanotus* of the Nicobar Islands. This genus extends also to Australia.

The dimensions of these bats are given by Dr. Horsfield as having an expanse of five feet, and the length of body at a foot; whilst Colonel Sykes declares that these dimensions are too small, and that he has seen them fourteen and a half inches long in the body.

The hairs are large and nearly smooth on the surface. The cuticular plates or scales are closely appressed, so that they bear some resemblance to those of human hair. There is a distinct medulla. In *P. Edwardsii* there is a slight appearance of longitudinal striation, but this may not belong to the scales, which are larger than in *Pteropus edulis*, and they appear to encircle the shaft, or at least I could trace no longitudinal partitions. When mounted in balsam the medulla is distinct on account of the enclosed air, and very small for the diameter of the hair.

More recently I have examined the hair of *Pteropus poliocephalus* from New Holland, and find a great similarity in structure to the hair of the Indian Pteropi. These constitute the FIRST group of nearly smooth hairs.

Closely allied to the Pteropi is a genus hitherto unknown in Continental India, but which occurs in Malayan countries and in Siam. This is *Xantharpyia*, the hair of which I have had no opportunity of examining.

The "Dogbat" of Java, *Macroglossus minimus*, belongs to the same family, and though not found in Continental India, it occurs in the Tenasserim provinces as well as Malayan countries.

Microscopically these hairs have an affinity with those of *Cynopterus* and *Megaderma*, to be noticed presently, rather than with the Pteropi.

The scales appear to be cylindrical, slightly expanding upwards, and entire at their margins. In balsam the medulla is distinct and large, and the outline of the hair distinctly serrated. The form of the scales becomes obliterated by their transparency in balsam.

A singular genus of Indian bats also have their place in this family, and are characterised, amongst other features, by the absence of distinct tails. The genus *Cynopterus* is believed by many to have only one representative in India, Ceylon, Burmah, Malaya, and the Nicobar Islands. The name applied by Mr. Blyth to this species is *Cynopterus marginatus*. Dr. Horsfield recognised three species, which he called respectively *Cynopterus titthæcheilus*, *Cynopterus marginatus*, and *Cynopterus Horsfieldii*. The two former of these Dr. Gray unites, and adds a third, under the name of *Cynopterus affinis*. The hair of the last I have not seen. Authentic specimens of the three supposed species of Dr. Horsfield I have examined, and find as great differences between two of them as between some species in other genera. However, little reliance

can be placed on the examination of the hairs of single specimens in the determination of species. Mr. Blyth's single species includes, as he believes, the three species of Horsfield as well as the three species recognised by Dr. Gray. The hairs of *Cynopterus marginatus* and *Cynopterus titthæcheilus* I cannot distinguish from each other, but those of *Cynopterus Horsfieldii* offer very marked differences. In all the scales are cup-shaped, and closely set on the shaft. As seen in balsam, they are not like the same objects examined dry, but become exceedingly beautiful from the large and distinct medulla, which is twice as broad in *C. marginatus* as in *C. Horsfieldii*, and the outline of the hair apparently fringed or barbed, whereas these barbs are but the side view of the scales, the front view being lost in their transparency. These apparent barbs are coarser and more closely appressed in *C. Horsfieldii* than in *C. marginatus*.

I am at a loss to understand the error into which so good an observer as Mr. Quekett must have fallen, when he wrote "the larger kind of hairs, such as are procured from the various species of vampire, are generally of a dark yellow colour, and are comparatively smooth, externally, but exhibit a cellular structure internally." He has evidently mistaken the large frugivorous bats for vampires, for the kind of hair which he has figured does not belong to the Asiatic vampires. The genus *Megaderma* represents the vampire in India, of which Mr. Blyth enumerates three species, one (*Megaderma lyra*) common in India generally, one (*Megaderma Horsfieldii*) found in the Tenasserim provinces, and one (*Megaderma spasma*) in Malayan countries. The *Megaderma schistacea* of Hodgson he quotes as identical with *Megaderma lyra*.

The hairs of *Megaderma lyra* have a rather closely serrated margin, the scales being somewhat crowded. The large medulla is very distinctly seen, even in the dry state, but when mounted in balsam or spirit, the hair appears to consist entirely of a broad medulla and a thin transparent fringed or ciliated margin. The hairs of *Megaderma spasma* are very similar, and not to be confounded with those of any other genus except, perhaps, that of *Cynopterus*.

Up to this point we have passed through two groups of hairs, nearly according with the zoological divisions of the animals yielding them. (1.) The large frugivorous bats of the genus *Pteropus*, yielding large, coarse, and almost smooth hairs, scarcely partaking

of the hair of bats. (2.) The vampire bats, including *Macroglossus* or the dog-bat, which is said to belong to the frugiverous bats; the bob-tailed bats, of the genus *Cynopterus*, which are also believed to be fruit eaters, and the genus *Megaderma* of the vampires. All these have much in common in the character of their hair. In all, the medulla is distinct and large, the scales are somewhat close together, and all exhibit a similar appearance when mounted in balsam. One might almost venture to affirm that, if any of these hairs were mixed with those of any other group to which I shall direct your attention, that it would be quite possible to indicate every hair that was so mixed, if the whole were immersed in distilled water or spirits

The third group includes three genera of what may be termed pseudo-vampires. They are the horse-shoe bats, of which we have representatives in Great Britain. The two genera of *Rhinolophus* and *Hipposideros* are so nearly allied, that some zoologists regard the one as a sub-genus of the other; and this is singularly borne out by an examination of the hairs, for not only is it exceedingly difficult to indicate any character whereby the hair of one species can be recognised from that of another, but it is also impossible to indicate any character whereby those of *Rhinolophus* can be known from those of *Hipposideros*. The third genus (*Nycteris*) offers a little modification of character.

The fourth group of hairs is of most interest to the microscopist, as it includes those having the margin of the scales serrated, notched, or toothed. As far as Indian bats are concerned, it includes the genera *Rhinopoma*, *Taphozous*, and *Nyctinomus*. I rather think that the genius *Molossus*, which is not represented in India, and which has very peculiar hairs in some of its species, must be placed here, as also the hairs which are mounted and sold as the hair of the Indian bat and the hair of Australian bat. Mr. Richter tells me that an Australian *Molossus* has most characteristic and beautiful hairs. Whatever the unknown hairs may be, I doubt not that the animal has a close affinity with *Rhinopoma* or *Taphozous*.

The genus *Rhinopoma* has one single representative in India and one in Africa, whereas *Taphozous* is represented in India by two species.

Rhinopoma Hardwickii, of all species of Indian bats, deserves most the appellation of long-tailed bat. Mr. Janson says, he should

think that the tail of the bat which he had seen as yielding the true "Hair of Indian bat," was full two inches in length. The tail in this species is about that length, the naked portion extending beyond the membrane, being two inches and a quarter.

The fifth group includes the one genus *Nycticejus*, the hairs of which present no affinity to those of either the preceding or succeeding group, but rather, perhaps, with those of the third.

All the species of *Nycticejus* which I have examined possess hair of a very similar character. It is, in fact, difficult to indicate any specific features, whilst generically, or in as far as the whole group is concerned, they possess a character which appears to be peculiar to them. The edges are deeply serrated, the scales appear to be irregular, but very indistinct, and when mounted in balsam, there is certainly, in some lights, an appearance of imbrication. I am, therefore, not prepared to say that the scales are cylindrical, nor can I affirm that they partake of the character of imbricated plates. I am disposed to think that the imbricated appearance is a deception due to the very great transparency of the hairs in balsam.

The last group is a large one, and includes the genera *Scotophilus*, *Lasiurus*, *Kerivoula*, *Vespertilio*, and *Plecotus*. The margins of the scales are usually oblique, darkened with deposits of pigment, and, especially in *Plecotus*, are sometimes only semi-cylindrical and alternate. The serratures at the edges of the hairs are seldom opposite, and the hairs themselves are slender. When mounted in balsam the presence of pigment in the scales is very distinct. These are all small bats, some of them the smallest of known species, and I am not sure that I could determine from an examination of the hair alone whether an individual was a *Scotophilus*, a *Kerivoula*, or a *Vespertilio*. Indeed I do not think that zoologists themselves are quite agreed as to the limits and distinctions of the different genera in this group. One calls *Lasiurus* a *Vespertilio*, another calls *Kerivoula* a *Vespertilio*, and another charges a fourth with making a *Scotophilus* a *Kerivoula*, whilst a fifth removes a *Vespertilio* to a new genus, and gives it a new name. This uncertainty shows that they are all very closely allied, and of this the hairs appear to afford corroborative evidence.

Having enumerated all the species of Asiatic bats of which I have examined the hairs (and which for convenience are grouped at the close of this paper), it remains for me to indicate those of which I am in ignorance. *Xantharpyia amplexicaudata* is a Malayan

species, and probably resembles *Macroglossus*. The species of *Pteropus*, *Megaderma*, *Rhinolophus*, and *Hipposideros*, unknown, it is presumed will not differ materially from those already examined. *Cælops Frithii* has occurred in Bengal, but I believe that only one specimen is known. *Taphozous saccolaimus* probably accords with the other two species of the same genus. *Cheiromeles torquatus* has such very short hair that it appears to be almost naked; it is confined to Sumatra, and therefore is not Indian. *Noctulinia noctula* is Himalayan as well as British. The species of *Nycticejus* not examined are probably very much like the four species to which I have alluded. *Scotophilus* probably offers in its other species counterparts of those already examined, and what remains of *Vespertilio* to be known, doubtless will partake of the same type as those already described. *Murina suilla* is a Himalayan species of which I have no knowledge, and it is the only one of its genus recorded in India. *Kerivoula pallida* and *Syckesii* it is presumed will not differ much from *Kerivoula picta*. *Myotis* has five representatives in India, of which one is also British. The common barbastelle, *Barbastellus communis*, is British as well as Indian. *Nyctophilus Geoffroyi* is European as well as Indian. Of all, therefore, which I have not examined, and which consist of about fifty species, there are only eight genera unrepresented, and of these one is unique, and four are European genera, leaving but three peculiarly Asiatic genera, and of these *Cheiromeles* belongs to Sumatra, so that *Xantharpyia*, which is a genus of frugivorous bats allied to *Pteropus* and *Murina*, which has but one Indian species, are all that really demand examination.

I think, therefore, if my researches have not been wholly exhaustive, that we have an approximate idea of the structure of hair in all the species of Indian bats as comprised in the three lists to which I at first referred. Although I do not wish to insinuate that there is specific character in the hair, yet I think that there is not the slightest reason to believe that any great dissimilarity will be found in the hairs of any species of a given genus of which the hairs in other two, three, four, or more species are known to resemble each other, and to follow a common type. If, for instance, in four species of *Nycticejus* the hair is so nearly alike as scarcely to be distinguished the one from the other, it is not illogical to conclude that in a fifth species there will be no great divergence from the type of the other four.

I think that I had better make a clean conscience and confess that I have not found a hair amongst any of the specimens that I have examined which is identical with that mounted by Mr. Topping as the hair of the Indian bat. Thus far, therefore, my labours have ended in a failure, but I cannot believe that my labour is wholly lost. What has been done contributes to lessen the work of any one who may think fit to follow me, and I hope that we may yet secure specimens of the long-tailed bat, and a more complete examination of hair from all parts of the body of both sexes of *Rhinopoma Hardwickii* may furnish more clue to the unknown hair. But on the supposition that even this fails I would fain believe that the examination of the hair of so large a number of well authenticated species will not be an unwelcome addition to our Microscopical Literature.

Amongst the hairs that have been examined I think that there are several which are well worthy of a place in any cabinet, and should we secure an active Indian correspondent, desirous of exchanging specimens with us, bat hair will certainly not be forgotten.

The examination just completed has impressed upon me the conviction that the two forms of hair seen in so many of the specimens represent the hair, properly so called, which overlies the other, and is alone exposed on the surface; this is coarser, smoother, and more deeply coloured. The under hair, or fur, is much smaller, more irregular, and with more expanding scales. What is designated "Hair of Indian bat," is a fur of this kind. One cannot help noticing the similarity in structure of this "fur" to the "down" of feathers, which appears to answer a similar purpose. Another circumstance is noticeable in some hairs, such as those of *Rhinopoma*, that the scales are further apart and more distinct, resembling a species of fur at their base, and more hair-like towards the extremity. This seems to point to a different function in the upper and lower portion of the hair—the one associated with the preservation of the heat of the body, and the other protection from external vicissitudes.

I am not sure that the character of the fur of animals does not undergo some modifications at different seasons of the year. We know that many animals exhibit externally a great difference in colour in winter and summer, and it is not improbable that the fur, or undergrowth, also undergoes modifications. I am not, how-

ever, in possession of any facts to support this hypothesis, but I think it is one which would furnish a useful series of observations.

I fear that the many imperfections of my paper will require a more ample apology than I can offer. This kind of investigation is new to me, and was only undertaken because of the facility I possessed of obtaining a large number of authentic specimens, and because of the continued enquiry about the names and hairs of Indian bats. I examined all the specimens dry, and in balsam, many in distilled water, and some in spirit. All were viewed with a $\frac{1}{4}$ and an $\frac{1}{8}$ objective, and the majority by means of polarized light. Altogether not less than 300 examinations were made, and about 200 separate sketches. Many friends mounted for me specimens, in addition to those I mounted for myself, so that altogether between 300 and 400 preparations were made. I am now convinced that the true character of the hair is only to be seen when it is mounted dry, and under a good strong light. At first I was a firm believer in balsam, but though I still think that all should be seen in balsam, it obliterates too much. The polariscope and $\frac{1}{8}$ object glass are great assistants.

Desirous that this paper should be made as useful as possible to the club, and as a kind of penance for the infliction, I present for its acceptance a series of the hairs described, mounted dry and in balsam, which I have made up to 100 slides. The diagrams exhibited this evening, and the portfolio which contained them, I also place at the disposal of the Club, so that it may possess the means of testing my observations.

(A Synopsis will appear in the next number with the third plate.)

NOVELTIES.

Growing Slide.—We are all acquainted with the "live box," its conveniences and its disadvantages. We know that it is not suited for very delicate manipulation, and that it is easily damaged. It is difficult to keep an object long in it, and not always easyto keep the living organism in the field of view. Mr. Curties, F.R.M.S., has greatly improved upon this old contrivance, by introducing a "live box" for aquatic objects, at once simple and effective.

It consists of a glass slide, 3in. by 1in., usually termed a hollow slip, in the centre of which is an oval or circular "well." At one end of the slide a small hole is drilled, through which passes a pin, having at the upper end a fine screw. This pin, or pivot, carries a brass button, to which is cemented an oblong thin glass cover. By screwing a smaller button to the upper end of the pivot the two surfaces of slide and cover are brought into contact. On moving the covering glass aside, the object, with a supply of water, may be readily introduced, and the cover being slid back into its place, the slide is ready for examination.

This slide cell offers unusual facilities for observing the habits of many interesting specimens of pond life, and forms also an excellent "growing slide." For this purpose, and generally when it is required to keep an object alive, it may be kept in a perpendicular position in a wide-mouthed bottle filled with water; or better still, a small glass tank may be made of a proper depth, having a wooden top in which holes may be cut as guides, through which the slide may be plunged when not required for observation. In this way a number of slides may be kept ready for use, and organisms in different stages of development may be isolated and watched, and their changes noted. Any apparatus which facilitates the study of the life history of any organism gives another step towards the increase of our knowledge, and Mr. Curties deserves our thanks for his simple, inexpensive, and useful contrivance.

"Coaguline."—Under this name a transparent cement has recently been introduced by Mr. Kay, of Stockport, which, we think, will be of use to the microscopist. It is extremely tenacious, and when slightly heated by placing the bottle in warm water, it may be applied by a camel's hair brush to the surfaces intended to be united. It soon sets, and so strongly that when used to join glass, the glass itself will often break on the application of force, before the cement fails. It promises well for the large built-up cells, or small tanks, such as the one just recommended for the reception of Mr. Curties' "slide cell."

QUEKETT MICROSCOPICAL CLUB.

DECEMBER 27TH, 1867.

ARTHUR E. DURHAM, ESQ., PRESIDENT, IN THE CHAIR.

The minutes of the preceding meeting were read and approved.

The following donations to the club were announced :—

"Leeuwenhoek's Works," 3 Vols.; "A Manual of Structural Botany;" "A Plain and Easy Account of British Fungi;" "Our Reptiles;" De Serres and Chabrier on "Insect Anatomy;" Griffith's "Asiatic Cryptogamia and Atlas;" "The Telescope and Microscope;" Otto Muller's "Von Wurmen;" Robin's "Du Microscope et des Injections;" Fonvielle's "La Monde Invisible;" and Trembley's "Polypes" (in German), from Mr. M. C. Cooke; Quekett's "Lectures on Histology," and Hannover "On the Microscope," from Mr. Wheldon; "The Naturalist's Circular," from the Editor; and "Science Gossip," from the Publisher; six slides of ferns were presented by Mr. R. T. Lewis, and specimens of Stephanoceros were sent by the Rev. John Hickley, and sections of wood by Mr. J. Marshall, both through Mr. Curties, who also contributed specimens of Conochilus, for distribution among the members.

A vote of thanks was unanimously passed in acknowledgment of these donations.

The following gentlemen were proposed for membership :—Rev. Andrew Johnson, M.A., Mr. Samuel Leith Tomkins, Mr. W. Warwick King, Mr. C. C. Jewell, Mr. Fancourt Barnes, Mr. Alexis Ricca, Dr. John Macdonald, Mr. W. H. Kirkby, Mr. C. J. Richardson, and Mr. F. J. Blandy.

Dr. Arthur Mead Edwards, President of the American Microscopical Society, of New York, was nominated, on the recommendation of the Committee, as an honorary member of the Club.

Eleven gentlemen, proposed at the previous meeting, were balloted for and declared duly elected.

The Honorary Secretary for Foreign Correspondence announced that he had received a letter from Professor De Notaris, thanking the members for the honour conferred upon him by his election as the first honorary foreign member, and promising to forward a copy of his latest work on "Italian Desmids." Mr. Cooke also announced that he had received some packets of diatomaceous earth from North America for exchange among the members, and suggested that all material and all slides sent in for the purpose should be correctly and clearly named.

Mr. Burgess then read the second part of his paper on "Wools," and the thanks of the meeting were presented to that gentleman for his paper.

Mr. Bockett directed the attention of the meeting to a simple live box, consisting of a ring of brass with a central hole, about one-tenth of an inch in

diameter, which ring is cemented to a glass slip, the cover being fixed in the centre by two small springs. The space being small, a living object is kept within the field of view of an object glass of two-thirds inch focus.

The President having announced that Mr. M. C. Cooke would read a paper "On the Hairs of Indian Bats" at the next meeting,

The proceedings terminated with the usual conversazione.

JANUARY 24TH, 1868.

ARTHUR E. DURHAM, ESQ., PRESIDENT, IN THE CHAIR.

The minutes of the previous meeting having been read, the secretary announced the following donations:—"The Naturalist's Circular," from the Editor; "The Popular Science Review," from the Publisher, and the Lord's Prayer, written in the two thousand five-hundredth part of an inch, from Captain St. John.

The thanks of the meeting were voted to the donors.

The following gentlemen were proposed for membership:—Mr. Thomas Crook, F.R.M.S., Mr. F. E. Leefe, and Dr. Dempsey, F.R.M.S.

Ten gentlemen proposed at the previous meeting were then balloted for and duly elected. Dr. Arthur Mead Edwards, of New York, who was proposed at the last meeting as an honorary foreign member, was also duly elected.

The President stated that the subject of the microscopic investigation of deep sea soundings having been brought before the notice of the committee, one of their number, Mr. Arnold, had communicated with Capt. G. R, Richards, R.N., as to the possibility of obtaining his help in the collection of the necessary material. Capt. Richards had expressed his willingness to assist, and with his letter had forwarded a box of specimens. It was proposed to form a committee of gentlemen having some knowledge of the subject, to examine the soundings thus obtained, and the names of gentlemen willing to join were requested to be sent to Mr. Arnold, who had consented to act as secretary of the sub-committee, when formed.

Mr. M. C. Cooke then read his paper on "The Hairs of Indian Bats" (see page 33), at the conclusion of which, he presented the whole of the slides illustrative of his paper, together with others, amounting to one hundred, to the Cabinet of the Club. He also presented the diagrams used by him, containing 43 figures of bats' hair, on an enlarged scale, with the portfolio containing them, to the library of the Club.

The especial thanks of the meeting were expressed to Mr. Cooke for his valuable paper, and for the handsome gifts accompanying it.

Mr. Burgess drew attention to the point that as bats' hair was so much serrated it ought to "felt" well, whereas there was no felting property. This fact seemed to coincide with his own deductions in his paper read at the last meeting.

The President announced that at the next meeting Mr. Hislop would give some suggestions on Oblique Illumination, and Mr. Draper would read a paper "On the proper application of the Microscope by Amateurs," and the meeting terminated.

FEBRUARY 28th, 1868.

ARTHUR E. DURHAM, ESQ., IN THE CHAIR.

The minutes of the previous meeting were read, and the following donations were announced :—" Land and Water," from the Editor. " Beale's Lectures on the Microscope and its application to Clinical Medicine," from Mr. Wheldon. " Remarks upon the Electric Telegraph" by the Rev. Thos. Fothergill Cooke. " Proceedings of the Bristol Natural History Society," from the Society. " The First Volume of the Naturalists' Note Book," from the Editor. Pritchard's " Infusoria," from the Rev. B. Compton, M.A. " The Naturalist's Circular," from the Editor. " Science Gossip," from the Publisher. Two engraved wood blocks of the enlarged Monogram of the Club, from Mr. Ruffle, and fifty slides from Mr. M. C. Cooke.

The thanks of the members were voted to the donors.

In presenting the slides, Mr. M. C. Cooke spoke as follows:—I have one or two observations to make respecting the slides. 36 of them are of hairs, but not bats' hairs this time; they are for the most part the hairs of Rodents. There is amongst them one of the hair of a jumping rat, a kind of jerboa, which I think the members of the Club will find worth the trouble of looking at. And whilst speaking of hairs, I would observe that there are many more kinds of hairs that are flat than have been hitherto supposed, and I find that in three genera of bats the hairs are decidedly flat. With regard to the hair of the mole, for instance, we hear the alternate diminishing and increasing of the diameter sometimes spoken of, whereas the diminished portions are merely side views of the hair, which is flattened. In the dormouse this is also the case. Another of the slides is of a rather curious object, the resin glands of a species of Euphorbiaceæ. They are little crimson glands, forming the bases of certain stellate hairs. The resin may be dissolved by spirits of wine, to which it gives a beautiful carmine colour; but this destroys the glands as microscopical objects. I should also like to mention that I have received from an American correspondent a communication respecting a new microscope, which has just been brought out there at the Boston Optical Works. They call it a Student's Microscope, and a photograph of it which I have here, represents it as something like one of our 5 guinea instruments, and its height is given as 15in.; but then it seems to have rather a higher stand than usual. The mirror can be removed from the stand when required, and used as a reflector to illuminate opaque objects, but the stage appears to have only the finger and thumb motion, which would suit our Continental neighbours. It is described as having coarse and fine adjustments; the coarse adjustment appears to be one tube sliding in another; the fine adjustment I cannot clearly discover. It is furnished with two objectives, a 1in. and a $\frac{1}{4}$in. For this, the sum charged is 65 dollars, or about £13 ! But when we consider that they regard this a cheap instrument, and that they have hitherto been paying as much as £12 10s. for one of our 5 guinea microscopes, we cannot wonder that, as a body, our American friends are doing so little with the microscope, since they have to do it at so great a cost. And whilst I am standing here, may I request the attention of our members to one or two facts respecting the condition of our cabinet? I do not think that the number of slides contributed is anything like what it ought to be; for, taking out of the

number those which I have given, and also those which have been contributed by persons not members of the club, there remains about half a slide to every individual. Now, I really do think that this is a state of things which ought not to exist, and that those gentlemen ought to feel a little ashamed who, whilst they benefit from the contributions of others, have never contributed themselves. I have, in conclusion, only to say, by way of stimulating the matter, that if one, two, three, or even six gentlemen, will together give 100 slides to the cabinet before the annual meeting, I will undertake to add another 100.

The President introduced to the meeting Dr. Thomas F. Purleigh, of Portland, U.S., who had brought an American objective of 1-15th inch focus, constructed by Mr. Wailes. It could be used both on the immersion principle and dry, and Dr. Purleigh was desirous of comparing it with objectives of English make.

The Secretary read the following names of gentlemen desirous of becoming members of the Club:—

Mr. Alfred Aubert, Mr. J. W. Morris, F.L.S., Professor R. V. Tuson, Dr. Daniel Moore, Mr. John J. Fox, Mr. John Oakeshott, Mr. John N. Burrows, Mr. J. P. Bidlake, F.R.M.S., Mr. Jas. How, F.R.M.S., Mr. John Bowing, Mr. Chas. Cubitt, F.R.M.S., Mr. Thos. Simson, Mr. Jas. Field, Mr. S. O. Gray, and Mr. J. R. Vallentin.

Three gentlemen proposed at the previous meeting were then balloted for and duly elected.

The President announced that the names of two gentlemen had been sent in for addition to the sub-committee appointed to examine the deep sea soundings now being received from various quarters, but that more gentlemen were required to properly carry out the investigation.

The President also announced that the following resolution had been unanimously passed at a meeting of the Committee held that evening:—

"That it is the opinion of this committee that ladies should be admitted as members of this Club."

The question would be discussed at the next meeting of the Club, which would be made special for the purpose, in accordance with the rules.

The Annual Soirée of the Club was announced for Friday, March 13th, and the President informed the members that a considerable number of invitations had been issued, and that a large assemblage was expected. He also paid a well merited tribute to the authorities of University College, who had met the Committee of the Club with the greatest possible courtesy, and had done all in their power to make the soirée successful.

The announcements of objects exhibited were as follows:—Mr. Potter, "Hair of Ornithorynchus;" Mr. M'Intire, "Wing of Adela Moth;" Mr. Curties, "Volvox Globator," and a new pocket cabinet for objects; Mr. Marks, "Some of the Microscopic results of a cold in the head;" Mr. Hinds, "Foramenifera from the Mediterranean;" Mr. Fred. Durham, "The Head of the Tape Worm of the Dog," and "The Echinococcus of the Human Subject."

Mr. Hislop then read "Some suggestions on Oblique Illumination." The paper was illustrated by diagrams.

A vote of thanks was awarded to Mr. Hislop for his paper.

Mr. Draper then read a paper "On the proper application of the Microscope by Amateurs."

The President fully accorded with Mr. Draper's remarks, and stated that he

intended to have followed the same line of argument in his future address. The concluding suggestion of Mr. Draper to form a collection of drawings of appearances as observed by the Microscopist, for the purpose of adding to the collection of the Club, he thought particularly valuable.

Mr. F. Durham, in a few remarks explanatory of the specimens he exhibited, said: Under this microscope, with an inch object-glass, is the head and part of the body of a tape-worm from the intestines of a dog. The head is provided with four suckers, and a double circle of very peculiar hooklets, by which it is firmly fixed to the interior of the intestine. This animal has neither mouth nor alimentary canal, but imbibes its food, already digested for it, through its tissues. The body, a small portion of which is shown, is made up of an immense number of similar segments, and in some species reaches a length of a dozen feet or more. Each segment may be said to be a perfect animal, for each possesses all the organs necessary for the production of a large number of ova. These ova, which are little roundish vesicles with hooklets, similar to those of the mature animal, pass through a variety of changes before attaining maturity. They are passed out from the bodies of their hosts, or the mature segment full of them is so passed, with the excrement. The ova are thus distributed over the country. Of course, happily, immense numbers perish; but many, in a variety of ways, get into the intestines of other animals. Thus they may be drank with water, or in the case of herbivorous animals, eaten with the food. It is only, however, in the intestines of some animals that they become at once developed into tape-worms; in others they pass from the intestines, either being carried by the circulation, or boring their way through the tissues until they reach a suitable spot.

The liver appears a very favourite place. In this organ one of these larvæ (as we will call them) may attach itself by its hooklets, and begin to grow. Its body swells and swells until it forms an immense sac, filled with fluid. At the same time there are developed, both inside and outside it, other similar little animals, which also grow in the same way, and inside them again others may be found.

Various diseased states are thus set up. The Hydatid disease in man is caused by the larvæ, or echinococci (as they are here called), from one species of dog's tape-worm, not however the one exhibited. Measles in pork, staggers in sheep, are caused by other varieties. When flesh thus infected is eaten, or the larvæ in any way gets into an intestine whose fluids agree with it, the head becomes attached to the mucous membrane by its hooklets, and from its posterior part true tape-worm segments are formed. These multiply very rapidly, and in a short time a perfect tape-worm is produced.

Under the second microscope, with a four-tenths objective, are some echinococci, removed during life from an hydatid cyst, in the liver of a young woman who was successfully operated upon a short time ago at Guy's Hospital by our President.

These animals are, certainly, not very agreeable ones to have to entertain as guests; but, apart from their associations, are very interesting to examine and study, from the peculiar changes they undergo.

The following papers were announced for the next meeting: "On some rare and undescribed Species of Infusoria," by Mr. Tatem, and "On a new Objective," by Mr. M. C. Cooke.

After the usual conversazione, the meeting terminated.

MARCH, 13TH 1868.

ANNUAL SOIRÉE OF THE QUEKETT MICROSCOPICAL CLUB, AT UNIVERSITY COLLEGE.

The second Annual Soirée took place at University College, Gower-street, on March 13th, 1868. The spacious halls and rooms of the building were placed at the disposal of the Committee by the Council of the College, and it is eminently due to that body to acknowledge the enlightened and hearty support they have afforded to the cause of popular science as represented by this and other societies.

The microscopes and collections of objects of interest were arranged in the principal library of the College, and also in the Anatomical Museum, which was specially fitted up for the occasion. A large dark room was provided in one of the corridors, where some of Dr. Maddox's exquisite Micro-photographs were exhibited upon the screen by the lime-light, and also some of the effects of polarization. Refreshments were served in two of the class-rooms and in the Museum.

The visitors began to arrive by eight o'clock, and were received at the head of the principal staircase by the President (Arthur E. Durham, Esq.), the Treasurer (Mr. Hardwicke), the Secretary (Mr. W. M. Bywater), and other members of the committee. About 900 ladies and gentlemen were present during the evening. One hundred and seven microscopes were contributed by seventy-five members of the club, and fifteen makers displayed ninety-eight instruments.

The deficiencies of the following account must be attributed to the difficulty of ascertaining what was really shewn, and to the impossibility of personally inspecting every object of interest in so great a multitude. It must be observed that extreme novelty, either in instruments or specimens prepared, can hardly be expected on occasions like these. Anything new is generally brought forward at the ordinary meetings of our societies, or published in other forms, not reserved for these annual occasions. But still an observant and experienced eye may form a judgment as to the state of the particular science which may be represented. It is much the fashion for individuals to express their opinion of their own attainments on these occasions by disclaiming the idea of anything whatever being new to *them*. They have seen it, or had it, or done it, often and long before. But it is equally certain that the most universal genius may obtain and does obtain hints and suggestions which, if they do not actually originate anything new, may modify conclusions or throw a different light on previous opinions. Giving the first place to the members of the Club, the following were noticed:—

Mr. Bentley.—A microscope supposed to be 200 years old.

Mr. Bezant.—A number of slides containing Foramenifera, Polyzoa, Diatoms, &c.

Dr. Braithwaite.—A collection of specimens and drawings of Mosses.

Mr. Burgess.—A large microscope giving a field of 23 inches in diameter. Preparations of a large size, both dry and in balsam; the latter chiefly consisting of whole insects, the slide being 3 inches by 2 inches and being capable of examination by the half-inch and four-tenths-inch objectives. Some pre-

parations were larger still, such as "Lucanus Cervus," and an Australian dipterous insect of the genus "Asilus," and to these was added a specimen of Euplectella Aspergillum. Mr. Burgess also exhibited beneath his microscopes a number of injected preparations and sections by polarized light.

Mr. M. C. Cooke showed three microscopic fungi.—The Gregarious Sphœria, Chain Brand on leaves of Burnet, and Vermilion Sphœria on currant twigs.

Mr. Thomas Curties.—A large instrument termed "The Engiscope," designed by Dr. Goring, and a valuable collection of gold and silver ores from California, also a beautiful series of Microscopic photographs by Doctors Curtis and Woodward, U.S.A.

Mr. Dobson.—Section of a Pearl.

Mr. A. E. Durham, the President.—A collection of Micro-photographs executed by himself.

Mr. Fred. Durham.—A section of human lung injected, and a series of specimens of *Acarus* (*Sarcoptes*) *Scabiei*, consisting of a full grown Acarus, a young one and two eggs, in a piece of skin cut from the finger.

Mr. C. J. Fox.—Polarized Crystals.

Mr. Hislop.—Selected Polycystinæ and Diatoms, and tongues of Mollusca with the shells of the animals, contributed by Dr. Dempsey. Also crystals of "Peacock" Salicine and Phloridzine, by polarized light.

Mr. R. H. Johnson.—Parts of Insects.

Mr. W. S. Kent.—A series of Water Spiders with their ova.

Mr. McIntire.—The Scorpion insect (*Chelifer Latreillii*), and its prey, a Podura (Lepidocyrtus) alive. *Polyxenus Lagurus*, a myriapod found under the bark of willows and elms, also alive.

Mr. W. A. Marsh.—Sea-weeds, Diatoms and Desmids.

Mr. Martinelli.—Madreporiform tubercle of Star fish.

Mr. Wm. Moginie.—A travelling microscope, portable lamp, portable air pump, portable object cabinet, &c., and a collection of Diatoms from Los Angelos.

Mr. G. Potter.—Hairs by Polarized light. Bone and teeth sections, and a collection of recent shells.

Mr. H. Scadding.—Scales of Scyllium by polarized light.

Mr. C. Stewart.—A table Polariscope.

Mr. F. Bedford also contributed a number of photographic views which were displayed in different parts of the rooms.

Among the makers of microscopes, the exhibitors were—

Mr. Baker.—Twenty instruments, and a collection of objects, among which were the Parasites of Elephant and Flying Fox, and a new species of Plant Bug.

Mr. Browning.—Four Microscopes, Spectroscopes, and Telescopes.

Mr. Collins.—Nine instruments, Injections of Human Lung, Human Kidney, Finger of Infant, Lung of Black Snake, and other objects, Fiddian's new "Eclipse" Lamp, with Metallic Chimney and Shade.

Mr. Crouch.—Eight instruments, new Rotatory Stage, improved Simple Stage, improved Parabolic Side Reflector, and a collection of objects.

Mr. Elliott.—A collection of scientific apparatus.

Messrs. Horne and Thornthwaite.—Microscopes and Telescopes, one of the latter mounted equatorially, Artificial Tourmalines, Ackland's Optometer and Tables relating thereto, Ackland's Alcohol Thermometer and Dividing Engines, Polariscope and Gassiot's Tubes, the latter shown illuminated.

Mr. How exhibited in the dark-room, Dr. Maddox's Micro-photographs on a screen 10ft. in diameter, the Oxyhydrogen Polariscope showing Polarization by pressure, Unannealed Glass, Selenite Objects, &c., Kaleidoscopic effects and Photographic Views. In the Museum ten Microscopes, Table Polariscope, Graphoscopes and Achromatic Stereoscopes, with Dr. Maddox's Stereoscopic Micro-photographs.

Mr. King.—Salmon Hatching, Marine and Fresh Water Aquaria and objects of Natural History.

Mr. Ladd.—Prisms and spheres of doubly refracting Spar.

Messrs. Loam and Fearns.—An adjustable rotatory microscope table.

Messrs. Murray and Heath.—Seven instruments and a collection of objects, Photographs and Stereographs.

Messrs. Newton.—Fourteen Microscopes, Photographs, and Slides.

Messrs. Powell and Lealand.—Three large instruments, and among other objects, the Circulation of the Blood in the tail of a fish, under the patent binocular arrangement for high powers.

Mr. Thomas Ross.—Six Binocular Microscopes, all of them with his new four-inch objective, showing the following objects:—Young Salmon (alive), Diamond Beetle, Ova of Toad, Head of Tiger Beetle, Sheep Tick, Elytron of Diamond Beetle, Haliotis shell section, Trachea of Centipede, Feet of Dytiscus, Elytron of Curculio splendens, Ciliary process of Eye of Ox, Iridescent oxide of Lead.

Messrs. Smith and Beck.—Eight instruments; the Eyeball of Cat showing entrance of Optic Nerve, Retina and vessels of the membrane Ruyschiana; Tooth of Cat injected, (unique) Acari of Water Rat. Human skin showing hair bulbs. Eggs and Parasite of Hornbill, &c.

Mr. Solomon.—The enlargement of the figures of microscopic objects and micro-photographs by the Magnesium Light.

Mr. J. H. Steward.—Ten microscopes; Circulation of the Blood in a frog's foot with a binocular under an inch and with Kelner's eye-pieces, giving a field of 18 inches; Parasites, Sea weeds, Spicules, Hairs, Crystals, and selections of Diatoms.

Mr. Wheeler.—A large collection of mounted objects.

THE JOURNAL

OF THE

Quekett Microscopical Club.

On the Hairs of Indian Bats, by M. C. Cooke.

Part II.—Synopsis.

GROUP I.

1.—Pteropus edulis. *Peron.*—('The Kalong.') Malay countries.—Animal upwards of a foot in length; hairs large and opaque; surface nearly smooth; cuticular plates small, imbricated, and closely appressed; medulla one-sixth to one eighth of the diameter; very distinct when mounted in balsam.—*(Pl. 1, fig. 1.*)*

2.—Pteropus Edwardsii. *Geoff.*—(The 'Wurbagool.') India generally, &c.—Animal upwards of a foot in length; hairs large and opaque; surface nearly smooth; cuticular plates large—generally cylindrical, or with the longitudinal divisions very indistinct; medulla one-sixth to one-eighth of the diameter of the hair; more distinct when mounted in balsam.—*(Pl. 1, fig. 2.)*

3.—Pteropus melanotus. *Blyth.*—Nicobar Islands.—Hair not examined.

4.—Pteropus Leschenaultii. *Desm.*—Southern India.—Hairs not examined.

5.—Pteropus poliocephalus. *Temm.*—New Holland.—*(Pl. 1, fig. 3.)*

6.—Xantharpyia amplexicaudata. *Temm.*—Malay countries.—Hair not examined.

GROUP II.

7.—Macroglossus minimus. *Geoffr.*—(The 'Kiodote, or Dog-Bat.') Malay countries, &c.—Neck, head, and face, covered with fine short silky hairs of a brown colour; on the anterior part of the back and on the body the hairs are longer and woolly. As the colour is more intense at the extremity of the separate hairs, different shades of brown and yellowish gray are exhibited, according to the undulations of the surface. Outline of

* All the figures are magnified 540 diameters.

hairs serrated; scales cylindrical, expanding upwards; entire at their margins. In balsam the form of the scales is almost obliterated; medulla distinct and large, occupying one-fifth of the diameter.—*(Pl. 1, fig. 4 dry, fig. 5 mounted in balsam.)*

8.—CYNOPTERUS MARGINATUS. *Gray.*—(The 'Margin-Eared Cynoptere.') Northern India.—Hairs rather translucent; outline deeply serrated; scales cylindrical, expanding upwards; entire at their margins; medulla large and very distinct in balsam, occupying two-thirds of the diameter of the hair. In this medium the hair becomes so transparent, that nothing is distinctly visible but a fringed outline and large medulla.—*(Pl. 1, fig. 8 dry, fig. 9 when mounted in balsam.)*

9.—CYNOPTERUS TITTHŒCHILUS. *Horsf.*—Has hair identical with that of *Cynopterus marginatus* Horsf., and both are included by Dr. Gray under *Cynopterus marginatus.*

10.—CYNOPTERUS HORSFIELDII. *Gray.*—(Horsfield's Cynoptere.) Java.—Hairs translucent, with a serrated outline; scales rather irregular in size, cylindrical, expanded, with entire margins; medulla distinct, when mounted in balsam occupying one-third of the diameter of the hair. In this medium the hairs become almost as transparent as those of the last named species.—*(Pl. 1, fig. 6 dry, fig. 7 when mounted in balsam.)*

11.—CYNOPTERUS AFFINIS. *Gray.*—Himalayas.—I have not seen the hairs of this species.

12.—MEGADERMA LYRA. *Geoffr.*—('Lyre-nosed Vampire.') India generally, (including *Megaderma schistacea* Hodgs.)—Hairs translucent, with a closely serrated outline; scales somewhat irregular, cylindrical, expanded upwards; medulla large and distinct even when examined dry, but becoming more distinct when viewed in fluid or mounted in balsam; occupying three-fourths of the diameter of the hair.—*(Pl. 1, fig. 10 dry, fig. 11 when mounted in balsam.)*

13.—MEGADERMA SPASMA. *Geoff.*—('Cordate Vampire.') Malay countries.—Hairs resembling those of the last species, but more irregular, and with the margin of the scales often oblique.—*(Pl. 1, fig. 12.)*

14.—MEGADERMA HORSFIELDII.—*Blyth.*—Tenasserim provinces.—Hair not examined.

GROUP III.

There is a great difference in the diameter of the hairs from the same animal in the whole of this group. The smaller hairs, which constitute the under-growth, or fur, are very peculiar. Their zigzag appearance, rough, gnarled, or knobbed outline, and great transparency, render them problems curious enough, but difficult to solve. In this group we encounter the first indication of what have been facetiously termed the 'sugar-paper scales,' somewhat obconic scales, with an oblique margin *(fig. 61 d.)* resembling the paper cones fabricated by the grocer to contain his 'pound of sugar.' Sometimes the side, sometimes the front, and sometimes the back of a series of these scales is presented to the observer, giving him very different appearances, and causing the impression of a greater variety than really exists. The

supposed spiral arrangement of the scales in Bat-hair, as alluded to by different writers, probably originated in the deceptive appearance caused by these 'sugar-paper scales.'

15.—RHINOLOPHUS PERNIGER. *Hodgs.*—' Sikkim Horse-shoe Bat.'—Nepal, Sikkim, &c.—Hairs translucent, with rather irregularly serrated outline; large hairs with cylindrical expanding scales, the margin irregular, often oblique; smaller hairs irregular, scales more expanded upwards, with oblique margin.—*(Pl. 1, fig. 13.)*

16.—RHINOLOPHUS MORIO. *Gray.*—Singapore.—Not examined.

17.—RHINOLOPHUS MITRATUS. *Blyth.*—Central India.—Hairs not examined.

18.—RHINOLOPHUS PEARSONI. *Horsf.*—(Pearson's 'Horse-shoe Bat.')—Sikkim Himalayas.—The length of this bat to the root of the tail is three inches, and the tail half an inch; expanse of wing eleven inches; the colour above is dark brown, with a slight shade of chesnut, underneath brown, with a sooty cast; the fur is very long, dense, and soft. Large hairs translucent; scales cylindrical, irregular, close together; small hairs irregular, with an angularly waved outline; scales expanding upwards with oblique margin.—*(Pl. 2, fig. 14 large hair, fig. 15 small hair.)*

19.—RHINOLOPHUS BREVITARSUS. *Blyth.*—Sikkim.—This species I have not seen.

20.—RHINOLOPHUS TRAGATUS. *Hodgs.*—('Nepal Horse-shoe Bat.')—Himalayas.—Both kinds of hair very similar to those of *Rhinolophus Pearsoni*, and scarcely to be distinguished therefrom, except that the smaller hairs have a less waved and angular outline.—(*Pl. 2, fig. 16 large hair, fig 17 small hair, in two positions.*)

21.—RHINOLOPHUS AFFINIS. *Horsf.*—('Malayan Horse-shoe Bat.')—Malay countries, &c.—Large hairs of the same type as in the species above described; small hairs more irregular in outline and angular than in the last; margins of the scales scarcely so oblique.—*(Small hair, Pl. 2, fig. 18.)*

22.—RHINOLOPHUS ROUXI. *Temm.*—('Bengal Horse-shoe Bat').—Bengal, &c.—Large hairs with the margins of the scales more or less oblique; small hairs straight, usually regular in outline, slender, with attenuated scales of the 'sugar-paper' type, resembling those of *Rhinolophus tragatus*, but longer, and slightly darker and more striate in balsam.—*(Large hair, Pl. 2, fig. 19.)*

23.—RHINOLOPHUS MINOR. *Horsf.*—('Little Horse-shoe Bat.')—Java.—Is apparently only a variety of the above.—*(Pl. 2, fig. 20, large hair.)*

24.—RHINOLOPHUS SUB-BADIUS. *Hodgs.* Nepal.—Character of the hair unknown.

25.—RHINOLOPHUS MACROTIS. *Hodgs.* Himalayas.—Hair not examined.

26.—HIPPOSIDEROS ARMIGER. *Hodgs.*—('Hodgson's Horse-shoe Bat.') Himalayas.—All the hairs larger than in the majority of species in this genus; large hairs scarcely serrate at the edge; scales irregular, margin often oblique; small hairs cylindrical, expanded, with oblique margins as in

the other species of the 'sugar-paper' type. *(Pl. 12, fig. 21 large hair.)*

27.—HIPPOSIDEROS DIADEMA. *Horsf.* ('Golden Horse-shoe Bat.')—More or less of an intense reddish or grayish brown above, assuming a golden lustre in certain lights, of a lighter grayish brown beneath; hairs smaller than the last, but similar in form; clear and transparent in balsam. This may probably not be the true *Rhinolophus diadema* of Geffroy.—*(Pl. 11, fig. 22.)*

28.—HIPPOSIDEROS LANKADIVA. *Kel.*—Ceylon.—Hair not examined.

29.—HIPPOSIDEROS INSIGNIS. *Horsf.*—Malay Islands.—Hairs semi-transparent; large hairs serrated; scales cylindrical, expanded, distinct, sometimes nearly plane, at others, oblique at the margin; small hairs as in other species. *(Pl. 2, fig. 23, large hair.)*

30.—HIPPOSIDEROS NOBILIS. *Horsf.*—('Noble Horse-shoe Bat.')—Burmese and Malay countries.—"Colour above pure brown, and underneath brown variegated with gray; the fur is long and silky, and supplied with a most delicate down at the base, so as to be throughout very soft to the touch." (Horsfield, Zool. Res.) Larger hairs translucent, with a serrated outline; scales cylindrical, expanded, entire, slightly undulated at the margin; small hairs regular, with a scarcely serrated outline; scales cylindrical, but little expanded, close, with oblique margins.—*(Pl. 11, fig. 24, large hair.)*

31.—HIPPOSIDEROS LARVATUS. *Horsf.*—('Masked Horse-shoe Bat.') Sylhet, Java, &c.—"Colour of a deep brown above, with a golden lustre more intense posteriorly; underneath, the hairs have a lighter golden tint; the long silky hairs are very soft to the touch and closely invest the body both above and beneath." (Horsfield). Large hairs serrated; scales cylindrical, margins nearly plane; small hairs, regular, scales compact, of the 'sugar-paper' type.—(*Pl. 2, fig. 26, small hair.*)

32.—HIPPOSIDEROS VULGARIS. *Horsf.*—('Java Horse-shoe Bat.') Java.—Large hairs resembling those of the last species; scales sometimes of the form represented by fig. 61 *b*; small hairs, slender, irregular, with a waved and angular outline; scales of the same form as in other species. (*Pl. 2, fig. 25, small hair*).—This is regarded by Mr. Blyth as the same with the foregoing.

33.—HIPPOSIDEROS SPEORIS. *Blyth.*—Southern India, &c.—This is believed by Mr. Blyth to include *Rhinolophus apiculatus* Gray, and *Rhinolophus penicellatus* Gray.—The hairs of none of these forms examined.

34.—HIPPOSIDEROS CINERACEUS. *Blyth.* Punjab.—Hair not examined.

35.—HIPPOSIDEROS MURINUS. *Elliott.*—('Mouse-coloured Horseshoe Bat.')—S. India, &c.—Large hairs more opaque and deeply coloured than in other species; almost smooth at the edge; scales often resembling *fig. 61 b.*; small hairs slender, often regular and straight; scales attenuated, cylindrical, with oblique margins.—(*Pl. 2, fig 27, small hair near the base.*)

36.—HIPPOSIDEROS FULVUS. *Gray.*—(Madras.)—Is referred by Mr. Blyth to the foregoing species.

37.—HIPPOSIDEROS BICOLOR.—*Temm.*—(Java.)—Hair not examined.

38.—CŒLOPS FRITHII. *Blyth.*—(Bengal.)—The typical specimen in the Museum of the Asiatic Society of Bengal is believed to be unique.

39.—NYCTERIS JAVANICA. *Geoff.*—('Javanese Nycteris.')—Malay countries. —Small hairs, with a rather deeply serrated outline; scales cylindrical, with an oblique margin; larger hairs less deeply serrated, and the margin of the scales seldom oblique *(fig.* 61 *c.)*; both kinds transparent, so that the outline of the scales may be seen through their substance; very transparent in balsam, but the margins of the scales still distinctly visible.—*(Pl.* 11, *fig.* 28 *)*

GROUP IV.

HAIRS CHARACTERISED BY THE SERRATED MARGINS OF THE SCALES.

40.—RHINOPOMA HARDWICKII. *Gray.*—(' Indian Rhinopome.')—India, &c.—Hairs somewhat translucent, with a deeply and acutely serrated outline; scales funnel shaped, with a broadly notched margin, expanding at the apex to twice the diameter of their base; in the larger hairs the scales are closer together than in the smaller ones; shaft near the root tapering *(fig.* 37*)* and nearly bare, colourless and transparent.—*(Pl.* 2, *figs.* 29. 30.*)*

41.—RHINOPOMA MICROPHYLLA. *Geoffr*—(' Egyptian Rhinopome.') Egypt.—The hairs are very similar to those of the last species, except that the margins to the scales appear to possess a larger number and more acute teeth. Some of the hairs are not distinguishable from those of *Rhinopoma Hardwickii.*—*(Pl.* 2, *fig.* 31.*)*

42.—TAPHOZOUS SACCOLAIMUS. *Temm.*—India, &c.—Hair not examined.

43.—TAPHOZOUS LONGIMANUS. *Hardw.*—('Long-armed Taphozous.') India, &c.—Body thickly covered with a very soft hair: in the adult it is of a snuff-brown, but the full-sized young are of a deep black on all parts. *Hardwicke*.) Hairs with a deeply serrated outline; scales funnel-shaped, with a serrated margin which is twice the diameter of the shaft; serratures of scales irregular; base of the shaft near the root transparent, colourless, and swollen in a fusiform manner (*Pl.* 2, *fig.* 36), a feature not observed in any other species.—*(Pl.* 2, *fig.* 32.*)*

44.—TAPHOZOUS MELANOPOGON. *Temm.*—(' Black-bearded Taphozous.') India, Java, &c.—The hairs of this species have a close resemblance to the last. The scales are, perhaps, a little more attenuated, but the distinctions are very slight.—*(Pl.* 2, *fig* 33.*)*

45.—CHEIROMELES TORQUATUS. *Horsf*—Sumatra, Java, &c.—Hair so short and sparse that the animal appears to be nearly naked.

46.—NYCTINOMUS INSIGNIS. *Blyth.*—China.—Hair not examined.

47.—NYCTINOMUS PLICATUS. *Blyth.*—(' Groove-cheeked Bat ')—Bengal and Malay countries.—This includes the *Nyctinomus tenuis* of Horsfield.—The body is deep brown, inclining to sooty black, intense above, and grayish underneath; the fur is extremely soft and delicate, closely arranged, and

of uniform length throughout. (*Horsfield.*) The hairs are translucent, with an acutely serrated outline; the scales are cylindrical, expanding upwards, rather distant, with a toothed margin; the hairs are transparent, and of a lighter tint than those of either species of Rhinopoma or Taphozous.—*(Pl. 2, fig. 34.)*

48.—TOPPING'S INDIAN BAT (Species unknown.—(Hairs rather opaque, dark coloured, with a very deeply serrated outline; scales trumpet-shaped, expanding at the margin to nearly three times the diameter of the shaft *(fig. 61 a.)*; margin with numerous acute teeth.—*(Pl. 2, fig. 35.)*

49.—AUSTRALIAN BAT. (Species unknown.)—Hairs rather opaque, dark coloured, with a deeply notched outline; scales broadly cup-shaped; more than three times the diameter of the shaft; margin with numerous teeth.—*(Pl. 2, fig. 38.)*

GROUP V.

50.—NOCTULINIA MALACCENSIS. *Gray.*—Singapore.—Hair not examined.

51.—NOCTULINIA NOCTULA. *Bell.*—(' Himalayas')—Europe.—Hair not examined.

52.—NYCTICEJUS ORNATUS. *Blyth.*—(' Blyth's Nycticejus.')—Himalayas. Hairs semi-transparent, with slightly serrated outline; scales indistinct, seldom wholly surrounding the shaft; margins usually more or less oblique. Hairs of all the species of this genus very transparent in balsam, and the scales apparently imbricated.—*(Pl. 2, fig. 39.)*

53.—NYCTICEJUS HEATHII. *Horsf.* Southern India.—Hair not examined.

54.—NYCTICEJUS LUTEUS. *Blyth.*—*(N. flaveolus* Bl., Yellow Nycticejus.) Bengal, &c.—The colour varies considerably in different individuals, being dark-brown above, in different shades, and rufous or yellowish underneath. *(Horsfield.)* Hairs similar in all the species, scarcely to be listinguished from each other; the scales of the hairs in this species are usually alternate, only half surrounding the shaft.—*(Pl. 2, fig. 40.)*

55.—NYCTICEJUS TEMMINCKII. *Horsf.*—('Temminck's Nycticejus.')—India and Malay countries.—A peculiar character is afforded to this species by the shortness of its fur; the colour is pure dark brown above, grayish brown, somewhat dusky underneath, with a rufous tint (*Horsfield*); hairs semi-transparent, slightly serrated; scales sometimes encircling the shaft, and at others only partially. The hairs of this, and also of the preceding, demand further and more complete examination.—*(Pl. 2, fig. 41.)*

56.—NYCTICEJUS CASTANEUS. *Gray.*—(' Chestnut Nycticejus.').—Malay countries; Bengal.—The characteristic feature of this species, Dr. Horsfield says, is the uniform deep chestnut colour of the body above and beneath; the hairs are semi-transparent under the microscope, with but slightly serrated margins; the scales appear to be usually cylindrical, with irregular margins, but sometimes only partially surround the shaft.—*(Pl. 2, fig. 43.)*

57.—NYCTICEJUS TICKELLI. *Blyth.*—*(N. isabellinus* Bl.,—Central India.) —Hair not examined.

58.—NYCTICEJUS ATRATUS. *Blyth.*—Sikkim.—Hair not examined.

59.—NYCTICEJUS CANUS. *Blyth.*—Bengal, &c.—Hair not examined.

60.—NYCTICEJUS NIVICOLUS. *Hodgs.*—Himalayas.—Hair not examined.

GROUP VI.

61.—SCOTOPHILUS SEROTINUS. *Geoffr.*—Europe; Himalayas.—Hair not examined.

62.—SCOTOPHILUS LEISLERI. *Bell.*—Europe; Himalayas.—Hair not examined.

63.—SCOTOPHILUS FULVIDUS. *Blyth.*—Tenasserim provinces.—Hair not examined.

64.—SCOTOPHILUS COROMANDELINUS. *Blyth.*—('Coromandel Bat.') India, &c.—Larger hairs with a minutely serrated outline, flattened; scales close, encircling, or only half encircling the shaft; smaller hairs broadly and deeply serrated; scales dark towards the margin, irregular, opposite or alternate, semi-ambient; shaft transparent. In balsam the larger hairs are transparent, the smaller are striated.—*(Pl. 3, fig. 44.)*

65.—SCOTOPHILUS FULIGINOSUS. *Hodgs.*—Nepal—Hair not examined.

66.—SCOTOPHILUS PACHYONYX. *Tomes.*—India.—Hair not examined.

67.—SCOTOPHILUS HODGSONI. *Gray.*—Calcutta.—Hair not examined.

68.—SCOTOPHILUS LOBATUS. *Gray.*—('The Lobed Bat.') India.—Both kinds of hair very similar to those of *Scotophilus Coromandelinus*; scales of the smaller hairs, but slightly coloured, closer together, and more regular towards the apices of the hair; in balsam the striation renders the scales very distinct in the smaller hairs; as in other species of this genus the small hairs are evidently flattened.—*(Small hair pl. 3, fig. 45; large hair fig. 46.)*

69.—SCOTOPHILUS MADERASPATANUS. *Gray*—('The Madras Bat.') Madras.—Larger and smaller hairs of the same type as in the other species; opaque and dark-coloured; serratures of the outline not so deep, and the scales of the smaller hairs less spreading; the opacity and darker colour distinguish these hairs from others of the same genus; very much striated when viewed in balsam.—*(Small hair pl. 3, fig. 47.)*

70.—SCOTOPHILUS FALCATUS. *Gray.*—India.—Hair not examined.

71.—SCOTOPHILUS FULVUS. *Gray.*—Madras, Java.—Hair not examined.

72.—SCOTOPHILUS LEACHII. *Gray.*—India.—Hair not examined.

73.—LASIURUS PEARSONI. *Horsf.*—('Pearson's Bat.')—Himalayas, &c. —Fur soft, thick, and rather long; on the upper parts tri-coloured, dusky at the base, succeeded by yellowish grey, and rufous at the tips; the general tint of the under parts palish brown; hair translucent, nearly smooth, with a scarcely indented outline; scales cylindrical, closely appressed, with entire margins; there is great variability in the dimensions of the hairs, some being one third the diameter of others.—*(Small hair, pl. 3, fig. 48. Large hair, fig. 49.)*

74.—MURINA SUILLA. *Temm.*—Himalayas, Java, &c.—Hair not examined.

75.—KERIVOULA PALLIDA. *Blyth.*—Central India.—Hair not examined.

76.—KERIVOULA PICTA. *Temm.*—(The 'Kerivoula.')—Bengal, Burmah, &c.—Fur of the body fine, without gloss, and nearly uni-coloured; that of the upper parts buff, with rust-coloured tips, of the under parts whitish buff; the larger hairs are slightly serrated; scales cylindrical, expanding upwards, with the margins entire and oblique; small hairs truncated-obconic, with oblique margins (*fig.* 61 *d.*) of the form described as 'sugar-paper scales.'—*(Small hair, pl.* 3, *fig.* 50. *Large hair, fig.* 51.*)*

77.—KERIVOULA FORMOSA. *Hodgs.*—Nepal, China.—Hair not examined.

78.—KERIVOULA PAPILLOSA. *Temm.*—(The 'Dusky Kerivoula.')—Bengal, Ceylon.—The fur is fine and woolly in texture, and very long; it is bicoloured, both above and beneath; on the whole of the upper parts it is dusk at the base, with the terminal third brown; beneath, it is dusky, tipped with yellowish brown *(Tomes.)* Large hairs closely and slightly serrated; scales cylindrical, short, and compact, with scarcely oblique margins; small hairs deeply and alternately serrated; scales half surrounding the shaft (*fig.* 61 *e.*) coloured more deeply towards their free margin.—*(Pl.* 3, *fig.* 52 *large hair, fig.* 53 *small hair.)*

79.—KERIVOULA SYKESII. *Gray.*—Calcutta.—Hair not examined.

80.—KERIVOULA HARDWICKII. *Gray.*—(Hardwick's 'Kerivoula.')—Java.—The fur is long, very fine, and woolly; that of the upper parts grey at the base, succeeded by a pale brown, and tipped with a slightly darker tint; general appearance buffy brown. (*Tomes.*) Large hairs resembling those of *Kerivoula picta (fig.* 51*)*; small hairs, with truncated, obconic scales, with an oblique margin ('sugar-paper' scales), rather more expanding than in *Kerivoula picta.—(Pl.* 3, *fig.* 54.*)*

81.—KERIVOULA TRALATITIOIDES. *Gray.*—Java.—Hair not examined.

82.—VESPERTILIO ADVERSUS. *Horsf.*—('Pallid Vespertilio.')—Bengal, Java, &c.—Fur every soft, long, and silky; above grayish brown, and underneath whitish; the tips of the hairs on the upper parts have a light greyish tint; and underneath, the silky down of the fur is greyish brown *(Horsfield).* Microscopically this hair resembles that of *Plecotus.* The serratures are deep and very decided, sometimes opposite, and sometimes alternate; the scales generally only half investing the shaft; the free margins darker than the base, which becomes very distinct in balsam.—*(Pl.* 3, *fig.* 55.*)*

83.—VESPERTILIO MURICOLA. *Hodgs.*—Nepal.—Hair not examined.

84.—VESPERTILIO MYSTACINUS. *Leisl.*—Sikkim.—Hair not examined.

85.—VESPERTILIO BLYTHII. *Tomes.*—India.—Hair not examined.

86.—VESPERTILIO CALIGINOSUS. *Tomes.*—India.—Hair not examined.

87.—VESPERTILIO SILIGORENSIS. *Hodgs.*—('Hodgson's Vespertilio.')—N. India.—Large hairs serrated; scales cylindrical, expanding upwards; margin rather oblique; small hairs slightly serrated; scales of the 'sugar-

paper' type, closely packed, small, and scarcely so spreading as in any species of *Kerivoula.—(Pl. 3, fig. 57 large hair, fig. 56 small hair.)*

88.—VESPERTILIO IMBRICATUS. *Horsf.*—('Horsfield's Vespertilio.')—Java.—"Fur both above and underneath is brown with a fulvous lustre," *(Horsfield)*; large hairs nearly smooth at the edge; scales crowded and appressed; small hairs serrated; scales cylindrical, nearly plane, margin entire or sinuated, when viewed in balsam striate. *(Pl. 3, fig. 58.)*

89.—VESPERTILIO TRALATITIUS. *Horsf.*—('Sooty Vespertilio.')—Java and Sumatra.—"Fur of moderate length, of a sooty black tint above, underneath sooty with a grayish cast," *(Horsfield)*; large hairs minutely serrated at the edge; smaller hairs more broadly and deeply serrated; serratures opposite or alternate; scales generally investing the shaft; margin waved, often oblique, slightly coloured; hairs becoming transparent and slightly striate in balsam.—*(Pl. 3, fig. 59.)*

90.—VESPERTILIO BLEPOTIS. *Gray.*—Timor.—Hair not examined.

91.—MYOTIS MURINUS. *Bell.*—Europe, Himalayas.—Hair not examined.

92.—MYOTIS BERDMOREI. *Blyth.*—Tenasserim provinces.—Hair not examined.

93.—MYOTIS PIPISTRELLUS. *Bell.*—Europe, Himalaya (?)

94.—MYOTIS THEOBALDI. *Blyth.*—Masuri.—Hair not examined.

95.—MYOTIS PARVIPES. *Blyth.*—Kashmir.—Hair not examined.

96.—MYOTIS LEPIDUS. *Blyth.*—Hair not examined.

97.—PLECOTUS HOMOCHROUS. *Hodgs.*—('Nepal eared bat.')—Nepal.—Hairs flattened, with a deeply notched or serrated outline; serratures opposite or alternate; scales semi-ambient, darkened towards their free margin, scarcely to be distinguished, except in size, from the following; the figures in the plate do not sufficiently indicate this difference.—*(Pl. 3, fig. 60 hair as seen in balsam, fig. 62 hair mounted dry.)*

98.—PLECOTUS DARJELINGENSIS. *Hodgs.*—('Sikkim eared bat.')—Sikkim.—Hairs flattened, smaller than in the above, with a deeply notched or serrated outline; serratures opposite or alternate; scales semi-ambient, darkened at the margin; striate in balsam.—*(Pl. 3, fig. 63, 64; hair in two positions.)*

Both the foregoing are undoubtedly identical with the British species *Plecotus auritus,* Bell.

99.—BARBASTELLUS COMMUNIS. *Gray.*—Europe, Himalayas.—Hair not examined.

100.—NYCTOPHILUS GEOFFROYI. *Leach.*—Europe, Himalayas.—Hair not examined.

NOTE.—The author would be glad to receive specimens of the hair of any of the species not yet examined, if the individuals from which the hair is derived are well authenticated.

Some Suggestions on Oblique Illumination. By W. Hislop.

(Read February 28th, 1868.)

The effect of passing the illuminating ray through a transparent medium of considerable refractive power, such as that which is presented by the ordinary glass slide, is not sufficiently considered by microscopists, and hence leads to considerable misapprehension, and in the act of manipulation to great loss of time and uncertainty of result. A moderate knowledge of the fundamental laws of optics or mechanics will often prevent us from attempting that which is impossible, as well as enable us to refer to their right causes the failures which we meet with. Thus, a man who understands the elementary principles of the science of Mechanics, and is practically acquainted with its details, even in a moderate degree, would hardly fall into the too common error of seeking for a machine to produce perpetual motion, or into the still more common one of endeavouring to originate force. And so with the somewhat more abstruse science of Optics. The laws of refraction are fixed, and we shall only succeed in our investigations when they are carried out in subjection to these known and immutable laws.

All objects which are permanently mounted so as to be viewed by transmitted light, are placed upon a plate composed of some transparent medium which is almost exclusively composed of glass. The means of illumination are various; direct light, or light reflected from the surface of a mirror, or through a prism, are severally used according to the fancy or means of the operator. This light is again often modified by pieces of apparatus called condensers, which, by their variety, complication, and consequent difficulty of manipulation, frequently bewilder the earnest student. But in all these cases we must remember that the ray of light, after it leaves our apparatus, whether that apparatus be simple or complex, does not reach our object without suffering a change, if that object be, as usual, supported on a plate of glass. Let us now suppose that we are examining—say, a frustule of *Pleurosigma angulatum* in the usual way. If it were possible to obtain a beam of light of which the component rays should be perfectly parallel, and if this parallelism could be so kept through object, objective, and eyepiece into the eye, we should probably observe the object

only in outline, and it would not be magnified; as it is, when we get our rays as nearly parallel as possible, they pass through the slide and the object, enter the objective (where the parallelism ceases), reach the eye through the eyepiece, and the object is seen with more or less distinctness, according to the quality of the objective. But we find, if we turn the mirror sideways from the axis of the instrument, so as to cause the ray of light to impinge on the surface of the slide at an angle, that we may obtain a more distinct view of both the outline and detail of the object; but in so doing, we have introduced a very important change in the condition of the ray of light,—it has become refracted or bent, according to fixed laws, when it touched the first surface of the slide.

Permit me here to allude to certain phenomena, which are, no doubt, comprehended by members of the Club, but which it is necessary to demonstrate in order to make myself clearly understood.

It is a law of refraction that a ray of light becomes bent when it passes from a medium of a certain density into one of greater density at any other angle than a right angle; hence a stick plunged into water appears bent at a point coincident with the surface of the water. If it were possible to plunge it into glass, it would appear more bent, because glass is a denser medium than water. The ray of light is refracted towards the perpendicular, when passing from air into water or glass *(see Fig. 1, pl. 4)*; but if the ray pass in the opposite direction—that is, out of a dense into a rarer medium—the bending is away from the perpendicular. If the medium be a plate of glass, with parallel sides, the ray is bent towards the perpendicular when passing through the glass, and away from it and parallel to its original direction when it leaves the glass again. *(Fig. 2, pl. 4.)*

The result of all this is that our ray of light which we have probably set at a certain angle—say 30 degrees from the perpendicular—passes through the glass at a considerably less angle, and leaves the glass and impinges upon the object at the original angle, provided the object be in the same medium as the original ray—that is to say, provided it be not mounted in balsam or fluid. If the object be mounted in balsam, that medium having nearly the same refractive or bending power as glass, the ray will not impinge upon the object at so great an angle as that of its original direction. The same effect takes place in fluid, but in a reduced degree.

But each case of bending or refraction has to a certain extent decomposed the ray of light;—it is no longer in the same state; dispersion has taken place, and colour has been produced which will often puzzle the observer, leading him to blame his object glass or his condenser, unless he is quite conversant with the different effects of chromatic aberration in these two combinations for widely different purposes.

But there is yet a phenomenon to be noticed, which is also invariable in its effects. If we incline our mirror still further from the axis of the microscope, we shall find that we shall arrive at a point when the light no longer passes through the slide, is no longer transmitted, but reflected; and at a certain angle for different media, this becomes total reflexion. The angle of total reflexion for water is given at 96°, and for glass at 83°. This very interesting and beautiful phenomenon, which almost seems to shew the materiality of light, forms the principle of construction of some of the best optical appliances used in the microscope. In the right angled prism, for instance, which makes the best reflector known *(Fig. 3, pl. 4)*, we have a figure of three sides, two of which are at right angles, or 90° with each other, and the third at an angle of 45° with the other two. A ray of light impinging perpendicularly upon the upper surface, passes through without change, but striking upon the inner surface dividing the glass from another medium of less density (namely, the air), it becomes reflected (not refracted), and passes out of the other face of the prism unbent, unaltered and therefore achromatic.

Take again the glass reflector used for the table polariscope. At a certain angle a portion of the rays having passed through the glass and impinged upon a non-reflecting surface, are absorbed, and the remainder are reflected in a polarised condition from the surface, if we observe at what is known as the polarising angle, which is for glass 56° 45′. If we increase this angle, total reflexion ensues, and the ray, resuming its original condition, is merely bent or reflected from the surface of the glass.

It follows from these considerations that there is a practical limit to the angle at which rays of light can be transmitted from one medium into another. In other words, *we cannot pass rays of light through a plate of glass so as to impinge upon an object on the upper surface of that glass beyond a certain angle.* If we employ such means as lenses to modify our illumination, we shall have

converging rays of light at different angles with the surface. Of these rays, those only which are within the angle of total reflexion for glass, will be transmitted at all; while those which do pass will be partly polarised, and have the total angle diminished within the transparent medium. *(Fig. 4, pl. 4.)* Thus, when we increase the aperture of our condensers, we often find confusion and fog, not from the quantity of light alone, but because an amount of reflection and dispersion has taken place which we are not able to control.

There are three remedies for this state of things, by which we may cause rays of light beyond the limit of partial or total reflexion to impinge upon our object. In a paper read in 1856, before the Microscopical Society of London, Mr. Wenham describes a method of transmitting a cone of rays at a great angle, by placing beneath the slide a prism or lens, with water, or better, oil of cloves, interposed between the two surfaces. The object was to get rays through at such an angle, that they would be reflected from the inner surface of the glass cover down upon the object, and so illuminate it as an opaque object; thus taking advantage of this property of total reflexion for a different purpose. But if we take a similar hemispherical lens, and attach it temporarily to the under surface of our slide by means of some medium as nearly as possible of the same density as glass, such as balsam or oil of cloves, we shall be able to transmit a very large angle of light. *(Fig. 5, pl. 4.)* This method will be chiefly available for objects mounted in balsam.

Another method is to adopt the principle of immersion employed with some of the continental objectives, by applying it to the condenser. A drop of distilled water, or better, of oil of cloves, placed on the upper surface of the condenser, and touching the under surface of the slide, will transmit a pencil of a larger angle than can otherwise be done.

Another method which I would suggest, is applied to the mounting of the object, and enables any degree of angle of illumination to be used, but has the disadvantage that the objects so mounted are more liable to injury than by the usual method. The structures which we require to examine by oblique light are very minute, such as diatoms. A drop of water containing the organism is spread on the surface of a clean thin glass disc, and dried by gentle heat. The minute particles so dried adhere with consider-

able tenacity to the glass. This disc is then mounted, objects downwards, on the ordinary wooden slide, with a large well chamfered central opening, and secured either by a slip of paper, by another slide superposed, or any other convenient means. (*Fig.* 6, *pl.* 4.) The surfaces exposed to light should be coloured a dead black. If laid object downwards in the drawer, no dust can fall on the preparation, or it may be covered, if thought desirable, by a small envelope when out of use.

I regret that want of time has prevented me from completing a course of comparative examinations of various structures under the conditions I have endeavoured to describe.

At a future meeting I may probably be able to state the result of these observations.

Some Cheap Aids to Microscopical Studies. By S. J. McIntire.

(*Read March 27th*, 1868.)

My object in the few brief remarks I am about to make is to bring forward certain cheap appliances, from which I have derived great assistance in my microscopical recreations, and which I can confidently recommend to the members of this club.

The first of these is an apparatus for the examination of such an object as a live flea, but it is available as a disc-holder in all cases where the observer can dispense with the refinements of optical work. It consists of a flat piece of mahogany, about four inches by two inches, and one-third of an inch thick, with a perforation in the centre, about $1\frac{1}{2}$ inches in diameter. A little cube of cork occupies the centre of the perforation, and is kept in its place by a piece of straight wire passing through it and the greater part of the long diameter of the block of wood. The free end of the wire has a round knob on it, enabling the little cube of cork to be rotated. (I use a hair pin and a glass bead.) To examine a flea, I first stupify it with chloroform, and then fix it to the cube in the position desired with a little strong gum arabic. By the time the gum is hard the effects of the choloform have passed off, and then a better view of a flea is obtained with the assistance of the two-thirds objective and Lieburkuhn than by any other means that I am acquainted with.* This apparatus may be used with advantage in the attempt to penetrate the mystery as to the functions of the pygidium. I was told that the pygidium is an organ of sensation, and that by blowing gently upon the insect, the long hairs from the centre of each of the areolæ in that object would vibrate. The vibration may certainly be seen, but as it is also to be produced by similar means after the death of the flea, it is not to be considered demonstrative proof of this supposed function; though I think it probable that the theory is true. By the time the discussion on the subject takes place at this club, perhaps some members may be able in consequence of their investigations, to give an opinion.

The second piece of apparatus is one for the examination of a tadpole, and I have the permission of the inventor, Mr. Alexander

* I borrowed the hint from Mr. Archer.

Fitzgerald, the associate of Mr. Whitney in his researches on that interesting creature, to bring it under the notice of the club. Two pieces of stout brass, about five inches by two inches, having large central perforations, over which thin glass is placed, are kept apart by a very stout India-rubber ring and bound together at the ends by screws, which are entirely removable. Few pieces of optical apparatus are so simple, and no animalculæ cage or compressorium that I know of answers the particular purpose for which this was made so perfectly. Not many observers are aware of the wonderful sight that the interior economy of the tadpole of the frog affords for a few days during its life; perhaps three days, four at most. At this period the skin of the belly is nearly transparent, and the blood in the internal gills and heart has become conspicuously brilliant—I suppose from its increased quantity. But I will not venture to describe the sight, as I fear I should soon get out of my depth in the attempt to deal with a subject so purely physiological. It is, nevertheless, most interesting and wonderful, as affording more than a glimpse of some of the mysterious operations going on in the very seat of life. To use the apparatus the two pieces of brass are separated, enabling the tadpole and a spoonful of water to be introduced into the cell formed by the India-rubber ring, which must be of proper thickness. Then the top piece of brass is put in its place, and the ends are screwed tightly together. The ends of the screws should permit either side of the apparatus to be uppermost on the stage of the microscope. The tadpole must be examined belly upwards, a position it cannot endure, so it makes violent efforts to right itself, and if the ring be too thick it will succeed, and turn over; on the other hand, if it be too thin the tadpole may be crushed by the pressure. Thus, rings of varying thickness are necessary. The inch and half power is the best for examination, and some means of condensing the light from the mirror must be adopted. The best effects I have seen were with Smith and Beck's $1\frac{1}{2}$ objective and Powell's condenser, from which the front lenses had been removed.*

I feel strongly tempted to speak of Mr. Curties's new growing slides, having for a long time past had a partiality for the cells he has improved upon by the addition of a sliding cover, but

* A common spot lens, with adjustable spot, answers admirably for similar purposes.—Ed.

any comments of mine on their merits are unnecessary, since they are already known to many of our members.* I have been keeping some aquatic specimens in them during the past fortnight and upwards; and during that period repeated observations have convinced me that those who *will*, have it in their power cheaply, and without much trouble, to write many fresh chapters of the "marvels of pond life."

Breeding Cages for Microscopic Specimens.

When I had the pleasure of calling the attention of this club to the subject of Poduræ I alluded to certain wooden cells which I had found of great use in my investigations. Since then I have had abundant experience of their utility, but having mentioned to Dr. Gray the only difficulty I encountered at times—that of the cells warping when wetted—he suggested the employment of sheet cork, such as is sold for lining entomological cabinets. I tried it, and after about three months' experience I have every reason to be much obliged to Dr. Gray for the suggestion. For most of the purposes to which I have applied them, they are now perfectly adapted, and exceedingly cheap, a dozen of them costing about half a crown. I make them thus :—A sheet of cork (varying in price from 4d. to 1s. or more, according to its thickness and quality), is cut into six or eight pieces, about two inches by three and a half inches An oval hole is punched out of the centre of each, and the edge of the aperture filed away in a gradually sloping direction. I then take a piece of stout plate glass of the same size, and put seven or eight layers of blotting paper on it.† Then on this I place the cork cell just made, and on the top a cover of the thinnest plate glass I can get, which I prefer to be only a little larger than the aperture of the cell, and bind the whole together with india-rubber bands.

Having put the captives into the cell, I dip the end of it into water, which immediately finds its way into the interior, aided by the blotting paper. Food is introduced by slipping the cover a little to one side, and if care is taken that the inmates are not subjected to many changes of temperature, but kept cool, and that sufficient, yet not too much food and moisture are introduced, observations on individual microscopic insects may be continued for

* See page 46.

† I prefer to use the very best cork, and pink blotting paper.

months. As an instance, I exhibit a nest of Poduræ, the individuals in which have furnished me with many hours of interesting employment during the past two months. Other specimens not so delicate as the Poduræ, have been in captivity for nearly a whole year in cells similar to those I am describing. In one I have eight specimens of the white Poduræ (a peculiarly delicate insect), which were imprisoned last October, *i.e.*, five months ago, and they still seem quite contented.

Provided with a good many of these cells, or similar ones, and determined to use them, I think our microscopical friends will find a new mode of utilising their captures of rare specimens, and a store of intellectual enjoyment in watching their habits and peculiarities, far beyond that found in merely multiplying the objects in their cabinets, even omitting all consideration of the value in a scientific point of view, that such observations possess.

Aided by these cells, I have been able to ascertain several additional interesting facts in the history of my microscopical pets. Thus, I am now quite certain that the species of Chelifer which I had the pleasure of describing last October is able to spin a web, and spends the winter in a silken home of its own making; but if the web be destroyed, it will desert the ruins of it to enter the web of another Chelifer, disputing possession with the rightful owner. The Poduræ, too, I find are occasionally guilty of cannibalism, eating up their dead brethren with evident satisfaction.

On Poduræ. By S. J. M'Intire.

(Read April 24th, 1868.)

Having lately, through the kindness of a friend. had the quiet perusal of Sir John Lubbock's three papers in the "Transactions of the Linnean Society," on the Thysanura, I beg to offer the following corrections and remarks on the notes upon Poduræ, which I had the pleasure of reading in November, 1866, and which appear, with illustrations, in "Science Gossip," vol. 3, page 53, &c.

The first illustration, figure 37, is *Isotoma trifasciata*, a species often occurring amongst moss in wet places, and at the roots of old trees. It is of a greenish yellow colour, with purplish brown patches, forming three, more or less, continuous bands down the back;—hence its name. The genus Isotoma has the four anterior abdominal segments sub-equal, and the two posterior segments small. It has hairs, but no scales; its antennæ are four-jointed and longer than the head, the segments being sub-equal, and the eyes are seven in number on each side, and arranged in the form of the letter S. Several species have been noted in England already.

Figures 38, 39, 40, 42, and 48, all refer to the genus Lepidocyrtus, probably *L. curvicollis*. From continued observations on the life history of this genus, I conclude that at different periods the creature wears different aspects. Thus, on escaping from the egg, it is plentifully supplied with hairs, which, I think, are clubbed similar to those which Sir John Lubbock says are peculiar to Degeeria and Orchesella only. At the first moult these hairs disappear, and slight iridescence is acquired, which in subsequent moults is increased, as is also the humped appearance or curvature of the neck, shown in figure 39, representing adult specimens. The renewal of the scaly armour is frequent; and since the skin below the scales is of a yellowish white, a specimen captured shortly previous to the operation is very likely to be taken for a different species. Questions that have been put to me by several members of the club on this point, satisfy me that this is a very frequent mistake. After the change, the colour, to the unassisted eye, is dull leaden black, but under the microscope, gorgeously iridescent. Large scales, the standard tests of the opticians, are

found only on certain of the largest insects, perhaps adult males; but I have not worked out this difficult question yet. The distinguishing characteristics of the genus Lepidocyrtus are:—abdominal segments unequal, with simple hairs and scales; antennæ long, four-jointed; eyes, eight on each side.

Figures 41, 43, 44, 45, and 49 refer to *Degeeria nigromaculata*. The genus Degeeria is one in which the species do not appear to be uniformly furnished with scales. Some are supplied instead, with a great abundance of hair. The distinguishing points of the genus, however, are as follows:—Segments of body unequal, with clubbed hairs, and sometimes scales; antennæ, filiform, four-jointed, and longer than the head and thorax; eyes, eight in number on each side. The body, too, is more or less spindle-shaped.

Figures 46 and 47 refer to *Templetonia nitida*. The antennæ are five-jointed, the basal joint being very short, and the terminal one ringed. The skin is of a pinkish brown, and is seen in many places between the delicate pearly scales as streaks and spots. The eyes are red, and the general form akin to that of Degeeria. I cannot say how many eyes this species possesses, owing to the extreme difficulty in counting them. In cultivated grounds a spadeful of earth will often disturb numbers, which run away, glistening like minute specks of snow. They often occur in damp cellars.

Figure 50 is the scale of a species of Macrotoma—probably *Macrotoma plumbea*. The distinctive characteristics of Macrotoma are:—abdominal segments unequal, with simple hairs and scales; antennæ very long, four-jointed, the two terminal joints being ringed; and the eyes are seven on each side.

This genus is remarkable for its activity. At Theale, my friend and I searched some old willows in an osier plantation, and the rapidity with which the Macrotomæ disappeared, in spite of their large size, just when we thought we had bagged them, was most provoking. They do not, as a rule, bear captivity so well as Lepidocyrtus; but I have one Macrotoma that has been imprisoned with about forty of this genus for about three months, and he often rushes about the cell in a frantic manner, to the great damage of the beauty of his fellow prisoners, who seem greatly frightened by his agility, and brush their scales off in quantities, in their efforts to get out of his way. I would rather he was out of his cell for this reason, but

to remove him and prevent the escape of the rest at the same time would be impossible.

Three other genera of the Poduridæ are alluded to in the learned papers from which I have drawn so much information, viz.: Orchesella, Podura, and Achorutes.

The antennæ in *Orchesella* are long and six-jointed, and the eyes six on each side, arranged in the form of the letter S.

Podura and *Achorutes* are nearly related. The antennæ in both genera are short and four-jointed, and the eyes eight on each side. The distinction consists chiefly in the saltatory appendage. In Achorutes it is extremely short, and in Podura it is of moderate length. Also, I notice that in Podura the single tenent hair on each foot, which, I think, Tuffen West was the first to notice and represent with his inimitable skill in the paper on the Feet of Insects, in the "Linnean Transactions," and which appears to be common to Poduræ generally, is absent, though it is very conspicuous in Achorutes. The last excursion party to Hampstead may remember taking some specimens there on the surface of the pool, which yielded Conochilus and Volvox so abundantly. These were *Podura Aquatica.*

Achorutes frequents old trees, damp walls and cellars, hotbeds and flowerpots, where decay is proceeding rapidly. A very dark purple species, often seen in wine cellars, is *Achorutes purpurescens.* Another species (*Achorutes armatus*), of a grey colour, is said to be common on stagnant water. It thus appears from my own observations that scales, perfectly distinct in character, are found on the genera Degeeria, Templetonia, Macrotoma, and Lepidocyrtus; each of them, when properly displayed, being an object of great beauty; and that Isotoma, Podura, and Achorutes are without scales—at least, in all cases that have as yet come under my observation.

As no specimens of Orchesella have presented themselves to my notice yet, I am doubtful as to this genus.

Mr. Ketteringham brought me a Podura scale last summer, which differs in shape and size from any I have yet seen: the form is far more regular, being always ovate, and the markings are very coarse, but somewhat like those of Templetonia. The insect was given me at the same time as the slide of the scales, but I was unable then to identify it; I, however, strongly suspect it was a species of Templetonia.

Spirit and water ($\frac{1}{7}$ spirit) seems to offer advantages as a medium for preserving specimens in for identification; although it does not add to their beauty, it enables several details to be seen that otherwise are invisible. Besides, the organ situated in Poduræ behind the third pair, and extending forward between the second and third pairs of legs, which evidently fulfils the double office of yielding a lubricating fluid, and of grasping smooth surfaces under peculiar emergencies when the insect is in danger of falling, I notice, also, another piece of apparatus about equi-distant from it and the root of the caudal appendage. Its use seems to be very obscure, and its structure is not easily made out. Having only lately observed it, I am unable as yet to say if it is always present, but it appears to be pretty constant.

As a conclusion to these imperfect notes, it may be well to remind beginners that the Order Thysanura has two great divisions—Lepismidæ and Poduridæ; that the second division, the Poduridæ are again divided into the three families:—

1. *Smynthuridæ.*—In which the body is more or less globular.
2. *Poduridæ.*—Having the body, which consists of eight or nine segments, linear.
3. *Lipuridæ.*—Having no springer, or only a rudimentary one.

Although the second of these families is undoubtedly the most interesting to microscopists, and especially to the Quekett Club, since Professor Quekett was, I believe, the first to give a really beautiful figure of the Podura scale, the study of the whole order will amply repay the labour, being almost untrodden ground—at all events in England; and the difficulty one finds who has not access to great libraries in obtaining information, is great in the extreme.

Many members of the Club seem lately to have found great interest in the subject, and it is to be hoped that our united efforts may help to make these curious creatures better known.

On Utilising our Excursions. By R. Braithwaite, M.D., F.L.S.

(Read May 22nd, 1868.)

About two months ago, Mr. Draper favoured us with some very pertinent observations on the work to be carried out by the microscope, and it is with the hope of impressing these views on the members taking part in the excursions that I venture to offer a few remarks.

On the 4th of this month I had the pleasure of meeting some thirty gentlemen at Hampstead, all duly provided with the armamentaria required for capturing the inhabitants of the various pools; the energy displayed in their application being quickly evident by an extensive array of bottles crowded with objects of various kinds—larvæ, crustaceans, rotifers, diatoms, desmids, and confervæ. Now these operations have been in progress for a considerable period of time, and so far as I can call to mind, we have heard nothing of their results: hence I conclude that after affording amusement for a few evenings to the collectors and their friends, the specimens have been thrown aside and forgotten.

May I suggest, however, that it is not by the cursory examination of a great accumulation of specimens that useful results are obtained, but rather by continued investigation of the structure and transformations of a single species or family, that we unfold its life history. One establishes facts on a scientific basis, the other leads to a *dilettanti* spirit of observation which can yield no profitable return.

I would ask, then, every worker to find out his hobby, and take every opportunity of trotting it out at our monthly meetings, for I am assured that when he does so it will be not only for the enjoyment of the members at large, but his own edification as well.

Again let me deprecate the notion that it is advisable to run after varieties, for how many common things yet await elucidation? How many members present are acquainted with the larva of the house fly? Or, to take those very collecting bottles I spoke of, in which the larva and pupa of the gnat were so conspicuous, one breathing by its head, the other by the tail, and both so different from the perfect insect that I am sure its biography might be made almost as interesting as that of the kindred *Corethra plumicornis* has recently been by Professor Rymer Jones.

Might I also venture to point out that there are many fields yet but partially explored, to which some of our members may profitably turn attention. The great class *insecta* yields endless material for microscopic investigation, in the minute parts of their general anatomy and their organs of manducation, respiration, and reproduction. The whole section Acarida is a sealed book to the bulk of British Natural History students, while the curious group of Thysanura is only just awaking interest here, for Sir J. Lubbock states that while 117 species are known on the Continent, scarce one-third of these are recorded as British. In this department, at least, I am pleased to find we have an active and intelligent worker. Many of the small algæ, too, yet await investigation, but above all, faithful delineation, and I trust we shall soon see Mr. Draper's suggestion acted on—viz., the collection of a series of drawings.

I regret that I have not time to study more than one department of Natural History, but having selected my hobby, and that precept may not lack example, I beg to lay before you the specimens of mosses collected on the excursions, hoping that they may be deemed of sufficient interest to find a place in the library of the Club, and to say that so far as opportunity permits, I hope to continue them by series from each locality we visit, so that eventually the Bryological flora of the metropolitan area may be represented by the individuals themselves.

And what do these specimens represent? Not simply so much vegetable tissue, but the actual physical conditions under which they were produced; for the experienced observer may decide at once by the examination of a suite of specimens, the nature of the soil, the relative humidity of the season or locality, and often the very altitude at which they were collected. What do these barren and stunted Hypna and Polytricha indicate but that the conditions necessary to their perfect development are wanting?—that the water and depth of soil they require are at a minimum, and that with the disappearance of the bog they also will cease to exist. Yet, that many retain their stations for a long period, may be seen by these specimens of *Hypnum stramineum*, still growing in the locality recorded by Dillenius 130 years ago. When with these are contrasted specimens from other stations not yet visited, the collection will not be found devoid of interest, or at least it may call to mind many pleasant hours spent in hunting out the

little noticed members of our native flora, when some of us may no longer be able to continue the pursuit.

As I find species of Hepaticæ are frequently confounded with mosses, I have included them in the collection, and have thought it might be useful to append to the specimens rough sketches of their structure on an enlarged scale.

The Hepaticæ present two general forms, one frondose, resembling the irregular thallus of a lichen; the other foliose or provided with leaves, and it is the latter which somewhat resemble mosses; but the leaves will almost always be found in one place, and arranged on the stem distichously, or in two rows; rarely of the symmetric outline observable in mosses, but often cleft or lacerated at the apex, or folded with a sacculate appendage at base. Frequently, also, the stem bears at the back an intermediate series of stipule-like organs named amphigastria; the cell texture is more uniform and less elongated than in mosses. Their fruit differs still more from that of mosses, and affords characters for three natural orders—

Ricciaceæ, in which it is a capsule embedded in the frond.

Marchantiaceæ, having capsules clustered round a stalked receptacle, and bursting irregularly.

Jungermanniaceæ, with a stalked solitary capsule, which bursts into four valves.

In none of these is there an included spore sac, or columella, nor any trace of the lid or beautiful peristome seen in mosses, but in the two latter orders the spores are intermixed with elegant spiral threads, or elaters, which no doubt facilitate their dispersion.

In touching on this topic, it is with the desire of showing that this Old England is not yet so worked out, but that it may yield ample store of the new and the beautiful to every earnest investigator; and in directing the attention of members to some pages of the great book ever open before them, let me hope that the time is not far distant when the Quekett Microscopical Club may become the head centre of all the field clubs in the kingdom.

On Microscopic Crystals formed at High Temperatures.

By T. Hookham.

(Read May 22nd, 1868.)

(The original source of this paper is to be found in an article by Mr. Thomas, of Oxford, printed in the "London Microscopical Journal" for July, 1866, and copied into the last edition of Dr. Beale's work on the Microscope.)

The following is a theory of "high temperature" crystals.

It is found that hydrous crystals, as prepared for the microscope, assume various forms according to the temperature at which they are crystallised. A solution is placed upon a glass slide, and rapidly evaporated over the flame of a spirit lamp. If this operation is properly conducted (and this is the first difficulty the amateur will encounter) a transparent film, much like a gum in appearance, is formed upon the glass. This film would appear to consist of all the constituent atoms of a crystal, with the exception of the atoms of water, without which, as is well known, the hydrous crystals cannot be formed. So long as the slide retains its high temperature the moisture in the atmosphere cannot condense upon it, and consequently crystallisation cannot take place. But it is obvious that by varying the temperature of the slide we can so regulate its relation to the temperature of the atmosphere that we can supply water to it by condensation in such quantity as we deem advisable. This, therefore, is the method of treatment. We take the uncrystallised and (so long as it remains anhydrous) uncrystallisable film, and subject it to a given temperature. If this temperature is sufficiently low it will absorb a certain amount of moisture from the atmosphere, and crystallisation will commence in a shorter or longer time, according, probably, to the proportion of water necessary to the formation of the particular crystal. If the temperature is low, say 60°, what is called a foliated crystal will be formed upon the slide, and this in a short space of time, perhaps from five to ten minutes. Having succeeded with this temperature, we may now try a higher, say 70°. A longer time will be necessary to crystallisation, and a different form of crystal will be formed. (Engravings of such crystals, taken from the accurate drawings of Mr. Thomas, of Oxford, will be found in the "Microscopical Journal," as above referred to, and in Dr. Beale's last edition.)

We may again try higher temperatures, till the limit is reached beyond which crystallisation cannot take place at all; and each time we shall find a variously modified form of crystal to have been produced; each higher form possessing increasing interest for the student.

So far we have for the most part followed Mr. Thomas. He found that about 110° was the greatest temperature at which he could obtain a crystal, and even then its formation occupied many hours. This practical difficulty cannot have been other than a source of disappointment to him, for up to this point some of the crystals steadily advanced towards a mathematical correctness of form, and thus gave promises which the highest temperature he could supply them with did not allow them to fulfil. The crystals of sulphate of copper in particular exhibited such an advance towards a mathematical form. Even the foliated crystals formed at 60° exhibit to the educated eye a twist in their lines, or a tendency to the spiral form. At 70° he obtained a circular or "centrical" crystal flowing out in waves from a fixed centre, and this still more strongly showed the spiral twist. At higher temperatures the waves became smaller, and the spiral more decided; and having with great difficulty obtained a crystal at 110° he found that the ultimate tendency was, beyond a doubt, for the spiral to become mathematically perfect, and the waves to vanish in pure lines. Such a crystal he has accordingly figured, as he was fully justified in doing, though he never obtained it absolutely perfect; and it may be added, the result has shown the sagacity of his prophecy.

It occurred to the present writer that, after all, temperature was only a means to an end, namely, the regulation of the supply of moisture; and though the most obvious, might possibly not be found the only means. It appeared likely that in Mr. Thomas' experiments with higher temperatures, it was not the small degree of moisture, but the great degree of heat operating *directly*, which prevented crystallisation. Since the direct influence of heat on the formation of crystals is a fact well established, the problem, therefore, appeared to resolve itself into this;—how, either to counteract the influence of the heat, or to gain the same power of regulating the supply of atoms of water by other and more indirect methods, combined with a lower temperature. For a long time this problem appeared insoluble. Months of experimenting gave a uniform result of failure in the attempt to improve the

method of crystallisation, a method which the writer ventures to believe represents a very important branch of the study of crystallography—perhaps the most important. The exception, as we all know, proves the rule—the scientific (not the popular) interpretation, which is that an examination of an apparently exceptional phenomenon points to the general law for the whole class. Here we force matter to crystallise under exceptional and artificial conditions. The resulting forms assumed, however, are not irregular, but most regular. Surely they should have exceptional significance; rightly interpreted, they must point to a true theory of crystallisation.

At last a successful experiment indicated the right method. This good fortune happened to the writer at Mentone, in the south of France, at a time when the hygrometer indicated extraordinary dryness even in that dry atmosphere: and it is not at all impossible that his success was in the first place owing to this circumstance. Feeling now, no doubt that he was on the right track, he first applied his new method to the crystal which Mr. Thomas had invested with an especial interest. In an experiment with sulphate of copper, a crystal was obtained at so low a temperature as 80° in which the spiral was mathematically perfect, and the lines not merely pure lines, but so finely ruled as to give *to the naked eye* the most brilliant effects of the interference of light the writer ever remembered to have seen, by whatever means produced. In some cases he has measured 6000 lines to the inch: and they often extend over an area of $1\frac{1}{2}$in. by $\frac{3}{4}$in. So that when held about half way between the eye and a candle about 5ft. distance in an otherwise dark room, the effects of interference are almost dazzling; while the lines themselves are so perfectly regular that it has occurred to him that in its larger sweeps, where the lines becomes nearly straight, or at least the curve is inappreciable, this crystal might even be used as a micrometer.

The spirals, as Mr. Thomas observed, have sometimes a right, sometimes a left-handed twist. The result of this is often somewhat unfortunate, for, as a rule, both twists occur in the same spiral. Radii proceed from the centre, marking the divisions between the two sets of curved lines, and thus cutting up the spiral into sections. There are almost always, however, on some parts of the crystal sweeps of lines sufficiently unbroken to give the spiral form in a very marked manner. Perfect spirals cannot at present

be produced in quantities; they occur only on a percentage of slides. But the writer does not despair of eventually discovering the law of their formation, since in some series of experiments they occur much more frequently than in others. In the meantime, he begs to present specimens of them to the Quekett Club for inspection, if it will honour him by their acceptance.

It only remains to add that by singular good fortune the process adopted in the first place for the purposes above spoken of, also serves another scarcely less important, and most efficiently. It not only in all cases greatly facilitates the production of the " anhydrous film," but it makes it possible in many cases where before it was impossible. Thus an unlimited field is open in which to apply this method of crystallisation. The writer has already done this to some extent with the most promising results. He is in treaty with a scientific chemist to supply him with some of the hydrous crystals recently discovered, and if the results answer his expectations he will from time to time offer to the general and scientific public such microscopic crystals as may seem in any especial manner to merit their attention.

The President spoke of the subject as being one of great interest, as leading towards the discovery of the ultimate forms of crystals.

Mr. Hislop said that he was not aware that the subject was to be brought before the club that evening till the commencement of the meeting, but he had himself brought a number of slides to shew some remarkable forms which he had obtained in the course of his experiments. He had for some time been working upon crystallisation under various conditions, and had found that the form of crystallisation was varied, not only by the temperature but by the rate of cooling, or heating the slide. In preparing the slides, he used a mounting plate of considerable thickness—a piece of half-inch boiler plate, heated by a gas or spirit lamp flame applied to one end. Measuring the temperature was attended with practical difficulties, as it could only be attained approximately, the temperature of the film not being exactly that of the glass slide, the supporting plate, or the air around. As an instance, he mentioned that merely placing a cover over the slide while the crystallisation was going on, materially altered the aggregate form of the crystals. If the salts or other substances in solution, could be reduced to a viscid condition by a high temperature, and the slide then dipped in some hydro-carbon—such as pure spirits of turpentine—the crystals would be found more perfect in outline and details, and the effects produced when examined by polarised light were among the most gorgeous that could possibly be conceived. He was still engaged on the subject, which was a very wide one, and hoped to be able to present the result of his experiments to the club. His own present conviction was, that we know very little about the laws of crystallisation, and certainly not enough to warrant us in hasty generalisations relating to crystallography.

QUEKETT MICROSCOPICAL CLUB.

MARCH 27th, 1868.

Dr. Tilbury Fox, Vice-President, in the Chair.

The minutes of the preceding meeting were read and approved.

The Honorary Secretary announced the following donations to the Club :—

"Report of the Bank of England Library ;" "Proceedings of the Bristol Natural History Society," from the Society ; "Science Gossip," from the Publisher ; "The Naturalist's Circular," from the Editor ; "Land and Water," from the Editor ; "Catalogue of Works on the Microscope," from Mr. Roper ; twelve slides from Dr. Dempsey ; fifty slides, mostly of seeds, from Mr. M. C. Cooke; five slides of Hippuric Acid from Mr. T. C. White ; twenty-four slides from Mr. M'Intire; and eight slides from Mr. Golding.

Mr. Hislop drew the attention of members to the slides presented by Dr. Dempsey, comprising a number of tongues of Molluscs, mounted, both opaque and transparent, and accompanied by the shells of the Molluscs to which they belonged. There were also some slides of selected Diatoms and selected Polycystins, and the first of a series of Test Diatoms which Dr. Dempsey intended to present to the Club.

The following gentlemen were proposed for membership :—Messrs. W. M. Holmes, Henry Withall, John Burrows, William Snellgrove, W. P. Bodkin, John Rigden Mummery, F.L.S., F.R.M.S., J. Howard Mummery, T. W. Burr, F.R.A.S., F.R.M.S., John Reynolds, John Garnham, F.R.M.S., John Rogerson, F.R.M.S., and Charles Baker, F.R.M.S.

The meeting was then made special, pursuant to notice, in order to consider a resolution for admitting ladies to the Club. The resolution, having been put from the chair, was negatived.

Fifteen gentlemen proposed at the last meeting were then balloted for, and duly elected.

Mr. Curties then read a paper on "Some rare and undescribed species of Infusoria," by Mr. Tatem.*

Mr. R. T. Lewis read a short paper on "The application of Berlin black to Microscopical Purposes."

Mr. S. J. M'Intire read a paper on "Some cheap aids to Microscopical study."

The thanks of the members were accorded to Messrs. Tatem, Curties, Lewis, and M'Intire.

The usual conversazione terminated the proceedings.

* Since published in "Science Gossip."

APRIL 24TH, 1868.

ARTHUR E. DURHAM, ESQ., F.L.S., PRESIDENT, IN THE CHAIR.

The minutes of the previous meeting having been read and approved, the Secretary announced the following donations :—

"Land and Water," from the Editor ; "Science Gossip," and "The Popular Science Review," from the publisher ; "Proceedings of the Bristol Natural History Society," from the Society ; "The Naturalists' Circular," from the Editor ; "The Collecting Book for Naturalists," from Mr. Hardwicke ; two diagrams of Mermis Nigrescens, and a slide of fragments of a meteoric stone, from Mr. R. T. Lewis ; twelve slides (anonymous) ; thirteen slides of Marine Algæ, and one of Navicula rhomboides, from Mr. H. Ambrose Smith ; and four slides, from Mr. Golding.

Mr. M. C. Cooke, the secretary for foreign correspondence, announced that he had forwarded forty-two copies of the circular of the Club to the President of the Portland (U.S.) Natural History Society, and that the committee of that society had undertaken to distribute them to Natural History societies in America, with a notice that "The Portland Natural History Society is in correspondence with the Quekett Microscopical Club, of London," and offering assistance to any one desirous of corresponding with the Club. Mr. Cooke also presented to the library, on the part of the president of the Portland Society, the first number of "The Molluscs of Maine, and their Palates," with the announcement that the work might be obtained by members for their own libraries in exchange for slides, the number to be agreed upon according to value. Some particulars were also given by Mr. Cooke of the Montreal Microscopical Club, which had expressed a wish to enter into correspondence with the Quekett Club.

The following gentlemen were proposed as members of the Club :—Dr. John P. Scatliff, Messrs. John Berney, F.R.M.S., John Rogers, William T. Hill, John Spencer, G. H. Fryer, F.R.M.S., J. G. Tatem, J. Hopkinson, William Rawles, Thomas Russell, Captain L. C. Bailey, R.N., F.R.G.S., Messrs. F. C. S. Roper, F.L.S., F.R.M.S., &c., &c., W. J. Browne, G. A. H. Dean, W. B. Ford, J. S. Pearsall, B. A. Hewitt, W. G. Cocks, T. C. White, F.R.C.S., F.R.M.S., E. G. Wild, J. G. Waller, W. H. Harris, F.C.S., Joseph Holdsworth, James Collins, W. G. Dresser, J. J. Hicks, W. M'Vean, J. J. Smith, F.R.M.S., T. D. Watson, and John Wigner, B.A.

Twelve gentlemen, proposed at the last meeting, were then duly elected by ballot.

The President announced that Mr. Marks and Mr. Martinelli had some special objects for exhibition to members, and that Mr. Reeves had presented specimens of Æcidium Violæ and Æcidium Ranunculæ for distribution.

Dr. Braithwaite read a paper "On Utilising our Excursions," illustrated by a collection of dried specimens and numerous drawings.

The President asked for a special vote of thanks to Dr. Braithwaite, which was agreed to with enthusiasm.

Mr. S. J. M'Intire read a paper, entitled "Some additional notes on Poduræ," which was illustrated by drawings. The thanks of the members were voted to Mr. M'Intire for his paper.

A paper by Mr. Slade, "On the Shells of the Crustacea," having been announced for the next meeting, the proceedings terminated with a conversazione.

MAY 22ND, 1868.

ARTHUR E. DURHAM, ESQ., PRESIDENT, IN THE CHAIR.

After the minutes of the preceding meeting had been read and approved, the Secretary announced the following donations :—" Science Gossip," from the publisher ; "Proceedings of the Bristol Natural History Society," from the Society ; " Land and Water," from the Editor ; " The Naturalists' Circular," from the Editor ; an Ancient Microscope (or Engiscope), supposed to be 100 years old, from Mr. Wright ; twenty-four Photo-Micrographs, mounted in a portfolio, from the President ; fifty slides, from Mr. Cooke ; and three slides from Mr. Martin.

The President called attention to the photographs of microscopic objects presented by him, and alluded to the circumstance that drawings very often represent the interpretation of the artist rather than the object as it is, while a photograph only shews what actually exists. A vote of thanks was accorded to the President and the other donors, for their valuable gifts.

The following gentlemen were proposed for membership :—Messrs. J. C. Barnard, Arthur H. Henry, Jas. Martin, Fred. R. Syms, W. Lindly, jun., Alfred Haward, J. W. Walker, Alfred Milledge, H. B. Briggs, Charles Dickens, James Smith, F.L.S., F.R M.S., Rev. Jas. Fry, M.A., and Lieut.-Colonel Jeakes.

Thirty gentlemen, proposed at the last meeting, were balloted for, and declared duly elected.

Among the special objects exhibited, the following were announced :—" A diamond-cut on glass, by polarised light, and the Pedicellaria of the Echinus, by Mr. Martinelli ; Desmids, collected at the last excursion, by Mr. Hainworth ; sections of crab-shells, by Mr. Slade ; Crystals of Sulphate of Copper, by Mr. Martin ; Crystals of Sulphate of Copper, shewing spiral striæ, by Mr. Hislop ; and the fructification of Todia Hymenophylloides, by Mr. Lewis.

Mr. Martin read a paper " On the Crystallisation of Sulphate of Copper at different temperatures," by Mr. Hookham. See page 80.

Mr. Slade read a paper " On the Microscopic Structure of the Shells of the Crustacea," which was illustrated by coloured diagrams.

The thanks of the members were presented to Mr. Slade for his paper.

Dr. Braithwaite presented specimens in continuation of the series of mosses found in the metropolitan district, and made a few observations on the following rare species now first recorded there :—Fissidens exilis, found by Mr. Reeves, near Keston Common ; Hypnum imponens, from Oxshot Common, Esher, (Prof. Lawson), being the second recorded British locality ; Buxbaumia aphylla, also discovered by Prof. Lawson, near Virginia Water, and very rare in England ; Hypnum illecebrum, found by himself on Barnes Common. He also exhibited specimens of Wolffia arhiza, a species of duckweed recently discovered here, and the smallest of the British flowering plants.

The President announced that the annual excursion and dinner would take place on June 23rd, at Leatherhead.

Papers by Mr. Archer and Mr. Moore were announced for the next meeting, and the proceedings terminated.

THE JOURNAL

OF THE

Quekett Microscopical Club.

On the Microscopic Structure of the Shell of Crustacea.

By J. Slade.

(Read May 22nd, 1868.)

The following notes on the Microscopic Structure of the Shell of the Crustacea are partly the result of an examination of a few slides prepared by myself at different times, and from different species of the group.

It is a subject which seems to me to be but little worked upon by microscopists in general, and it is mainly the desire to make it better known, rather than to add anything to that which is already recorded, and also the greater desire that it may lead to discussion, which always gives so much life and energy to our meetings, that I have complied with the request to introduce it to you this evening. About two months ago I brought the same subject before the members of the N. L. N. Club, and several gentlemen now present will, doubtless, remember it resulted in a warm discussion—the very best effect which a paper of this kind can produce; and although conflicting theories could not be reconciled, yet I am sure we were all benefited by the trial of our microscopic and reasoning powers.

The shell of the common crab may be taken as the type of structure of the shell of all crustacea, and is much more complex than the shell of any Echinoderm, Mollusc, Brachiopod, or even than tooth or bone. It consists of four layers, with tubules like those of dentine, traversing them at right angles, or nearly so.

Dr. Carpenter, in the Report of the British Association for 1848, noticed this tubulated structure, and since then it has been described

by Quekett, in his Histology, by Huxley, in the Cyclo. Anat. and Physiology, and by Professor Williamson, in the "Transactions of the Royal Microscopical Society."

The four layers of which the shell is composed are well seen in a section of a piece of the carapace, taken at right angles to the surface. It is then found that the external and internal layers are entirely structureless—the external probably forming a mere protective covering to the middle layers,—the internal, probably, in the course of growth becomes converted into the adjoining layer. These layers are membranous and structureless, and do not contain calcareous matter. The inner layers are known as the areolar layer and the corium. The areolar layer is the uppermost of the two, and lies immediately beneath the external layer. It is termed cellular by Dr. Carpenter, but Huxley and Williamson have shown that it is not cellular; but upon its surface, immediately in contact with the external layer, it is seen to be areolated. The vertical section shows it to be composed of thin laminæ. Beneath this areolar layer lies the calcified corium,—this is also composed of fine laminæ. These laminæ, at first, lie flat and horizontal with the inner layer, but gradually, at numerous points, they rise, and at last become so much inflected that they ascend like flat-topped cylindrical pillars, penetrating the areolar layer, and reaching the external pellicle, and there form the white spots seen on the surface of the crab's shell. The tubules composing the tubulated structure traverse the areolated layer and corium at right angles to the laminæ, of which they are composed; and where these are inflected the tubules bend to suit the altered condition of things. The tubules of the areolated layer can be seen easily, and are large compared with those of the corium, which are very fine, crowded and confused, and not easily traced in balsam mounted specimens.

Flat sections of the shell, those made parallel to the surface, present very different appearances according to the position at which they are taken.

In a section of the claw it is seen that the corium does not rise in cylindrical pillars, and the tubules are more distinctly seen and more closely resemble dentine.

The structure of the shell of the crab is that which is always found in all the most highly organised forms of the Decapodous Crustacea. And in the group Brachyura all the layers previously described are present, and the variations consist in the different

degrees of development and position of the laminæ and tubules. In the group Anomura, or soft-tailed crabs, and of which the soldier and hermit crabs are members, the difference of structure is not very great, and this agrees well with the known difficulty that is often found in separating some of the members of the two groups.

In the group Macroura, represented by the lobster, shrimp, cray-fish, &c., the difference is considerable, although not so great as one would conclude from a more casual inspection. The calcareous matter in the corium of the lobster is very dense and opaque, rendering it difficult to make a good transparent section, whilst in the common shrimp a section of the shell at right angles to the surface shows the four layers present, but in a very attenuated form, and the calcareous matter locally diffused.

The most remarkable feature in the integument of the shrimp consists of numerous discs, the result of a secondary calcification, which becomes incorporated with the pre-existing tubulated calcific deposit. The brown carapace of *Argulus foliaceus*, mounted in dilute glycerine, shows well the hexagonal divisions of the areolar layer.

In examining a portion of a cast shell of *Limulus*, a junior specimen, I found very little calcareous matter. Throughout the preparation were to be seen a number of centres which, under the polariscope, showed the black cross, beautifully defined, and closely resembling those centres shown in an elytron of a coleopterous insect.

At the close of the paper,

Mr. Martinelli called attention to the fact that the cuticular layer becomes separated if the shell be treated with dilute hydrochloric acid.

Mr. Breese stated that he had utterly failed to make out the tubes in sections prepared in the usual way. In pieces chipped across the shell at right angles to their directions he had, however, detected them with the one-eighth objective. He believed that the grinding process filled up the tubes, and thus rendered them invisible. He had tried hydro-chloric acid, but had failed to separate the layers so as to render the tubes visible.

On the Application of Berlin Black to Microscopic Purposes. By R. T. Lewis.

(Read March 27th, 1868.)

In using Brunswick black for object mounting, I have frequently found cause of complaint against it, on account of its want of opaqueness, its highly reflective surface, the stickiness which sometimes remains for days after it has been applied, and the difficulty of making a thin coating of gum spread evenly upon its surface. I therefore thought it desirable to find, if possible, some substitute which, whilst possessing all its good qualities, should not possess any of its bad ones; and it occurred to me that Berlin black might meet the requirements of the case. I, therefore, made trial of it, and have found it so well to answer the purpose in every respect, that I have no hesitation in strongly recommending its use to others. When applied to glass, or any other non-absorbent substance, it dries perfectly in the course of a few minutes, with a beautifully smooth, dull surface, upon which thin gum water will spread as easily as upon paper, whilst for all practical purposes, it may be said to be opaque, which properties render it exceedingly useful for spotting the interior of cells in which it is intended to mount objects dry for lieberkuhn illumination. When used for finishing off slides, its blackness is obviously a great improvement upon the treacle-brown of the Brunswick, and if the comparative deadness of its untouched surface should be objected to, a slight amount of rubbing with a soft piece of cloth or silk will produce a polish upon it equal to that of black marble (and it is for this latter quality it is so highly prized by metal workers, who use the Brunswick black for common purposes alone). It is also a very excellent stain for wood, and, as such, is frequently employed in the transmutation of beech into ebony. As regards supply, although it may possibly be new to microscopy, it is an article in every-day use; but as there are several kinds in the market, it may be as well to state that what is known in the trade as Iles's Berlin Black is greatly to be preferred to any other. This is retailed, in green labelled stone-ware bottles, at 1s. and 1s. 6d., the smaller size containing about one quarter of a pint.

On Tobacco. By J. A. Archer.

(Read June 26th, 1868.)

(Abstract.)

After enumerating the different qualities of leaf tobacco, chiefly, it would seem, arising from the climate and soil of the place of growth, the paper proceeded to describe the method of culture, resembling, in many respects, the procedure followed in raising vegetables in our own market gardens. The chief enemy of the growing plant seems to be what is called the "horn worm." This is the larva of one of the Sphingidæ, or hawk moths, described as the Sphinx Carolina, an insect of four inches and a half expanse of wing. These caterpillars are said to cause great damage to the crop.

When the crop is cut, the leaves and stems are partially dried, then allowed to ferment in heaps, and subsequently cured, or more completely dried. The tobacco is then packed under pressure, and conveyed to the various markets.

Tobacco contains the peculiar element, nicotianin, which gives the peculiar odour, and nicotine, an alkaloid, combined with gum, tannin, gallic acid, resin, and other vegetable products. The burnt ash gives potash, soda, lime, magnesia, chloride of sodium and potassium, phosphate and sulphate of lime and silica.

A transverse section of the midrib, or any of the veins in the leaf, exhibits, under the microscope, the appearance of a horseshoe, surrounded on all sides by cellular tissue (*Fig.* 1, *Plate* 5). The horseshoe is made up of the cut extremities of the spiral or pitted tissue, which gives strength to the stalk. On the outer surface are numerous hairs, of peculiar form—one of the principal indications with the excise for detecting the admixture of other leaves by the manufacturers. These hairs vary in size, are tubular, and composed of several cells joined together (generally from four to six), the terminal one, in most instances, having a gland attached, consisting of one or more small cells, filled with dark granular matter, and the basal cell is mostly much longer than the other. Sometimes a few hairs may be found with an obtuse rounded extremity, without the gland. Occasionally there are a

few club-shaped hairs, the extremities of which are divided so as to form a number of small cells containing within their cavities a dark brown colouring matter. These short hairs are found on all parts of the leaf, but are more numerous on the midrib and veins, but are not very abundant. (*Fig.* 1*a*, *pl.* 5.)

The author of the paper directed attention, in passing, to the subject of vegetable hairs generally, with the especial object of ascertaining their particular use in the economy of the plant, the existing theories concerning which appear to be very vague.

The cellular tissues of tobacco may be said to consist of three kinds:—

First. Cells of an hexagonal or octagonal form, found in the transverse section of the midrib.

Second. Elongated hollow cells, joined together, found in the epidermis of the under surface of the midrib.

Third. Cells, with waved borders, found on the upper and under surface of the lamina of the leaf.

Tobacco contains no raphides, but in the green state a minute quantity of starch is found, the granules of which are very small, and are found near the midrib. In form, these granules are round and irregularly oval, in some instances present a flattened surface, and occasionally they present a very minute hilum in a central position.

In consequence of the high duty on tobacco, a considerable temptation is offered to adulterate the staple, both in its raw and manufactured state. To prevent the practice, a penalty of £200 may be enforced for the introduction of anything but water. The principal adulterants are mechanical, and may be readily detected by the use of the microscope. Among the substances used are the leaves of rhubarb, dock, burdock, coltsfoot, foxglove, thorn apple, cabbage, lettuce, and chicory. Also, sugar, treacle, molasses, liquorice, gum dextrine, Irish moss, common salt, copperas, and flour. In snuff have been found ground dye woods, such as fustic, logwood, Brazil wood, and sumach; peat moss, ground pine, beech, and birch; the starches or flour of maize, orris root, wheat, oats, potatoes, &c.; chalk, oxide of iron, yellow ochre, and probably many others.

The following are a few instances:—

1. *Rhubarb.*—This is distinguished from tobacco by the bundles of woody fibres being scattered irregularly, instead of being

gathered in a horseshoe shape in the centre of the veins The hairs, also, are short, one-celled, and finely striated, the striation resembling dots. (*Fig.* 2, *pl.* 5.) Rhubarb contains a large quantity of raphides, tobacco containing none.

Rhubarb leaves have always been a favourite adulterant; they readily take up tobacco liquor, and, when so prepared, have to the naked eye a striking resemblance to tobacco. Less than one per cent., however, is easily detected by the microscope, owing to the abundance of raphides, and the peculiar kind of hair.

2. *Dock.*—In dock the bundles of woody fibre are found very similar to those in rhubarb, but more regular. The hairs are one-celled and coarsely striated; they are also frequently narrower at the base than at the top. (*Fig.* 3, *pl.* 5.) Dock contains raphides, like rhubarb, and is readily distinguished from tobacco. Several striking differences may be observed between dock and rhubarb, such as the regular shape of the transverse section of rhubarb and the irregular shape of dock; the prominences on the dock (in which the cellular tissue is extremely fine), which prominences are absent in rhubarb; the form, size, and striation of the hairs; the presence of hairs on all parts of the rhubarb leaf and the absence of them on all parts of dock leaf, except midrib and veins.

3. *Thorn Apple.*—The vascular tissue in this plant is arranged in horseshoe form, not unlike tobacco. The hairs, however, differ entirely from tobacco, being of two kinds, sessile and jointed (or glandular and lymphatic). The glandular hairs are very short, consisting of a single cell terminating in a bulb, the bulb resembling that on tobacco hairs; the lymphatic hairs are composed of from two to five joints, terminating in an obtuse point, each joint having the appearance of being dotted over. (*Fig.* 4, *pl.* 5.) Thorn apple belongs to the same natural order as tobacco. It contains no raphides.

4. *Burdock.*—The vascular tissue is arranged in the form of oval bundles. This plant is also distinguished by the form of its hairs, being composed of a large number of short cells, joined end to end in the form of a chain, terminating in a long filament. It is this kind of hair which gives the burdock leaf its soft, downy appearance. (*Fig.* 5, *pl.* 5.)

5. *Coltsfoot.*—In a transverse section of coltsfoot the vascular bundles are similar in shape to those in burdock, but the number of them is generally limited to three. The hairs are very similar to those of burdock, but shorter in the joints. (*Fig.* 6, *pl.* 5.)

6. *Chicory.*—In a transverse section of chicory, the vascular tissue is arranged in the form of oval bundles. The hairs are long and of a complicated structure, each joint being made up of small cells, the last joint generally terminating in a bulb. (*Fig.* 7, *pl.* 5.)

7. *Cabbage.*—This is distinguished from tobacco by its vascular tissue being in the form of wedged-shaped bundles.

8. *Potatoe.*—The horseshoe here is very like that in tobacco, but smaller; but the hairs, which have from two to seven joints, are all pointed.

9. *Henbane.*—This is more like tobacco in microscopical structure than any other leaf at present known. Its horseshoe is small, but resembles that in a small tobacco leaf; its hairs are jointed, the first joint being similar to the first joint in tobacco, and the hairs frequently terminate with a bulb. A little experience, however, renders it easy of detection:—thus the hairs appear very transparent and very weak, each hair being folded on itself; so that it is difficult to see from top to bottom the whole of one side of the hair. Again, the bulb on the end is devoid of granular matter. Lastly, another kind of hair is frequently met with—namely, a jointed hair, with a long filament or whip. This of itself is sufficient to distinguish it from tobacco.

10. *Foxglove.*—The character of the hairs is shewn in *fig.* 8; they are easily distinguishable from the hairs on the tobacco plant. Foxglove is but rarely used as an adulterant.

Thorn apple, potatoe, and henbane belong to the natural order Solanaceæ, to which tobacco also belongs, and they present the closest approach in appearance to that plant. It will be seen, however, that distinguishing features exist which can easily be detected by the aid of the microscope, and not only the kind but the proportion of adulteration exactly determined.

Most of the other adulterations previously mentioned are detected by chemical means.

PRESIDENT'S ADDRESS, DELIVERED AT THE ANNUAL MEETING, JULY 24TH, 1868. BY E. DURHAM.

GENTLEMEN,—

My year of office as your President has now come to an end.

It is true, you have done me the honour to elect me your President for the ensuing year. It is also true, that I fully appreciate the high compliment you have been so good as to pay me, and that I hope to have the pleasure of again taking this chair at your next meeting. None the less, this evening I retire from office: and so, in accordance with a custom I would gladly abolish, but which I am bound to adopt, I rise to offer you a few remarks.

I freely confess I feel considerable difficulty in entering upon the task before me. By my position I am shut out from all other than general topics; and the remarks I address to you must be more or less general in character. But general remarks upon general topics do not often possess any particular interest. It is sometimes as hard to listen to such remarks patiently, as it is always hard to utter them pleasantly. I trust, however, to your kind consideration and indulgence.

In my present difficulty as to the subject matter of my address, precedent affords me but little aid.

The substance of Presidential addresses to Scientific Societies, so far as I know, may, as a rule, be arranged under three heads: first, we have obituary notices of members deceased during the past year; next, allusions to new instruments, or other aids to research; and lastly, an epitome of recent and important advances in the particular branch of science especially cultivated.

Now, fortunately or unfortunately, as the case may be, it happens that there is little for me to say on the present occasion that can fairly be discussed under any one of these heads of discourse.

In the first place, it is true that during the past year two or three members have been lost to us by death. We regret most sincerely *our* loss. We sympathise with those—relatives and friends—who have been bereaved, and who still mournfully feel *their* greater loss. We trust our expressions of sympathy will be accepted.

But the late members of our club to whom I refer, however dear to their several families, however highly honoured and esteemed in their respective social circles, do not appear to have contributed in any notable degree to the advancement of microscopical knowledge. There is, therefore, nothing for me, in my present capacity, to record respecting them.

Next, with regard to improvements made during the past year in our instruments—the microscope itself, and the various appliances and contrivances useful in microscopical research.

I do not know that anything has been done to which I am especially bound to direct your attention.

Many ingenious devices have been from time to time conceived, and many clever little dodges (if you will allow the expression) have been made known, by means of which time and labour may be saved, or increased facilities for observation afforded. The publication of such devices and "dodges"—trifling as they may seem to some—is, I think, highly commendable, and very much to be encouraged. Cleverness in little things often constitutes the great difference between the successful and the unsuccessful microscopist. A hint from the clever contriver, or a glimpse of his contrivance, sometimes proves of the greatest value to the industrious and honest, but hitherto unsuccessful worker. Many unpretending little instruments and methods of the kind I am alluding to, have been brought before the members of our club. It is to be hoped that many more will follow. Our meetings afford peculiarly good opportunities to those who have anything of the kind to shew or to suggest,—tempting opportunities, indeed, to all who can be tempted by the prospect of unostentatiously, but certainly, rendering their own experiences useful to others of kindred tastes and pursuits.

Beyond the minor aids which I have thus mentioned collectively, little or nothing worthy of note has been recently brought out.

We have among us many able and eminent makers, who certainly surpass all foreign competitors in the excellence of their workmanship, if not in the lowness of their prices. Probably they could tell us, if they would, of the successes they have severally achieved in disposing of very many microscopes during the past twelve months. Such successes on their parts, may fairly be considered matter for congratulation on ours. The sale of an increasing number of good instruments affords unimpeachable evidence of a growing interest in the use of the microscope; and the distribu-

tion of such instruments through town and country implies a wider and more general spread of opportunities and facilities for microscopical research.

But no great improvement has been effected of late in the microscope itself; and no addition of striking importance has been made to our accessory apparatus. This can be no matter for surprise—hardly perhaps for regret. The ingenuity and skill of the makers, aided by the suggestions and directions of practical microscopists, have "developed" the microscope to its present state of high excellence with an almost marvellous degree of rapidity. We can well afford to await with patience the still higher excellence which sooner or later will certainly be attained. Multiplication of specimens, rather than elevation of type, has of late been the order of the day among the microscopes.

In the introduction to the first edition of his well known treatise on the microscope, Dr. Carpenter says—"The statements of theorists as to what *may* be accomplished, are so nearly equalled by what *has* been effected, that little room for improvement can be considered to remain, unless an entirely new theory shall be devised, which shall create a new set of possibilities." But since this passage was written many important advances have been made. Wenham's Binocular has been invented and come into general use. We have been furnished with object glasses of far higher power, with better definition and greater facility of working than would then have been deemed possible. Objectives on the *immersion system* have been successfully made and advantageously used. The Spectroscope has been applied to the microscope. Such and such like improvements have been effected within the last few years. We cannot be too cordial in our acknowledgments of what has been done. But still we may look with hope and confidence for something more. Granting that the stage of *theoretic perfection* has been reached, there is yet ample scope for *practical advancement* in various directions. At any rate, it seems so to me. Permit me to indicate one or two directions in which I venture to think something *may* be done, and to state my reasons for hoping that ere long something *will* be done.

It appears to me that the Stereoscopic Binocular Arrangement is not even yet so fully appreciated as it ought to be. Some of its advantages are sufficiently estimated, but others, and those perhaps the greatest, are almost ignored.

Every microscopist whose eyes are equal, recognises at once and without difficulty the stereoscopic projection and apparent solidarity, and the infinitely greater beauty and perfection of form which certain objects consequently present when viewed through the Wenham Binocular. Every one, also, who tries the experiment readily becomes conscious of the fact that it is much more comfortable,—much less tiring to the eyes and brain,—to watch an object for any length of time under the binocular than under the monocular microscope. The pleasure derived from increased perfection of view, and the comfort arising from less urgent sense of fatigue, are immediate advantages readily appreciated. The ulterior and, as I think, greater advantage of the binocular, depends upon the comparative safety with which it may be used. Frequent and, from time to time, continuous use of the monocular microscope is much more liable to result in permanent damage to the eyesight than a corresponding use of the binocular. That it must be so is obvious. Every one accustomed to the use of both eyes, who by accident is for a time dependent upon one eye, or any one who, for the sake of experiment, may choose to make himself thus dependent, speedily finds out that one eye serves him *less* than half as well as two, and much sooner becomes tired. In order that they may be maintained in well-nourished, healthy condition, the eyes, like all other organs of the body, must be used and exercised. Now exercise and use may be continued with advantage and safety up to a certain point. Beyond such point, which may be called the *fatigue point*, exercise tends to exhaustion; use becomes abuse; and more or less lasting damage is liable to result. Experience teaches us that the fatigue point is reached much sooner when we use the eyes singly, or either eye by itself, than when we use both together. But this is not all. We can see very well with one eye; we can see best, however, not simply when we use both eyes, but when both eyes act precisely in unison. To preserve perfect vision, therefore, the integrity of each eye must be maintained; and more than this, the natural sympathy and consentaneity of action of the two must be kept up. Now, when we look at an object under the monocular microscope the eye which we use is subjected to very different conditions to the other. The eye which we use "accommodates" and "adjusts" itself to the requirements of its present purpose. The other eye at first sympathises to a certain extent; but its external circumstances are altogether different;

and just in proportion as it sympathises in accommodation and adjustment with its fellow, is it out of accord with its own proper condition. This is true, whether it be closed, as is sometimes the case, or open and gazing at vacuity. By and bye the unused eye ceases to a certain extent to sympathise with its fellow. Still later, the fault which has thus arisen incidentally may become habitual. In this manner the constant use of the monocular microscope may tend to break the consentaneity of action of the two eyes, and so lead to impairment of perfect vision. It is clear that such a result arising from such cause may be in great part, if not wholly, obviated by using both eyes at the same time under the same conditions. We do this when we look through a rightly adjusted binocular microscope. It is not, then, so much for the sake of the greater beauty of the view, as for the sake of saving the eyes that I urge so strongly the use of the binocular in every case in which the power it bears is high enough for the observation to be made.

It seems to me that since the invention, and I may almost say the perfection of the achromatic objective, no service has been rendered to microscopists at all equal in value to the introduction by Mr. Wenham of his stereoscopic binocular arrangement. Those eminent men who first made for us the achromatic objectives have enabled us to see what otherwise might still have been beyond our ken; and Mr. Wenham has done much to save our eyes. The one great drawback to Mr. Wenham's arrangement is, as you all know, that it cannot be used with the higher powers: and yet it is with such that we want the binocular most, for they are most trying to the eyes.

I should do wrong if I omitted to allude to the binocular arrangement for high powers invented by Messrs. Powell and Lealand: all honour to them for what they have done. Most of us have seen various objects shewn by these gentlemen under their arrangement; and all who have seen such objects must have been struck by the admirable manner in which they were displayed. But the arrangement of Messrs. Powell and Lealand has a defect, which, from what I have said, you will readily understand seems to me more important than it may seem to some—perhaps more important than it really is. The defect to which I allude is this: there is a very great difference in the amount of light transmitted to the eyes—one receives much more than the other. Further, I

am not aware that this arrangement has yet been made universally applicable.

What we want is some binocular arrangement suitable for high and low powers indifferently, and so arranged that the two tubes of the microscope are equally inclined. In using the present arrangement, the axis of vision of the right eye is directed straight forward, and the axis of the left eye is of necessity inclined abnormally inwards. The natural convergence of the axes of vision is thus disturbed, and the left eye is for the time made to squint inwards to a greater or less degree. This is clearly objectionable, on more grounds than one.

So, then, it seems to me that the fuller development of the Stereoscopic Binocular is one of the great advances in connection with the microscope that we have strong reason to hope may ere long be accomplished.

Another *desideratum* is some better means than we at present possess of increasing our magnifying power without diminishing our field of view.

Mr. Ross's admirable new four-inch objective and other similar glasses, which work well with the deeper eyepieces, may perhaps be regarded as more or less successful attempts in this direction. But every microscopist knows the discomfort associated with the use of the deeper eyepieces as at present constructed. May we not legitimately hope that some improved arrangement may hereafter be devised.

Thus, gentlemen, not being able to announce to you any striking improvement recently effected in our instruments, I have ventured, with all deference, to point out one or two directions out of many in which there is yet ample scope for advance.

Thirdly. With regard to the progress of Microscopical Science during the past twelvemonths.

So far as I have been able to learn, no great discovery has been made; no new method of research, of distinguished merit, has been devised; no fresh field of wide, general interest has been opened up. But discoveries, such as are sometimes said to mark epochs, are not made every day nor every year. Nor, indeed, does it always happen that such discoveries are of the greatest real value; although seemingly they may be, for a time, the brightest. We have ample evidence that, during the past year, a large amount of good honest work has been done. It is true the general tendency of

such work has been to confirm or controvert observations and statements already published rather than to bring forward anything new, or establish absolutely any important result. Those who regularly read the current microscopical literature, will readily allow that this is true. The journals teem with notices and records of work carried on in almost every department of Microscopical Science. It would, obviously, be impossible for me on the present occasion, to epitomise fairly all that has been published, even in one department, much less in all. And it would seem invidious to single out for special praise or criticism, any individual contributions. Many have appeared that are of great value; but I do not know that any can indisputably claim preeminence. I may be permitted, however, to allude to two or three subjects which have of late engaged the attention of many able microscopists, and which seem to me not only to deserve, but to demand, and that without delay, still further investigation

First and foremost there is the minute anatomy of the nervous system, especially as regards the so-called terminations of the nerve fibres in muscle, and in the several organs of sensation. The results of Dr. Beale's well-known investigations have been disputed by many who have adopted different methods of research. To some, perhaps, it may still seem an open question whether or not Dr. Beale's statements will, in the main, be proved worthy of general acceptance. It would be out of place to enter upon the discussion now But I cannot allow this opportunity to pass without expressing my own admiration for the exquisite beauty of Dr. Beale's preparations, and my high appreciation of the ability and untiring industry with which he has worked out and supported his conclusions.

Again: Hallier and others have been of late, and are still, engaged in the study of certain minute living organisms, which appear to be the concomitants, if not the causes, of the various so-called septic diseases, such as cholera, fever, pyæmia, &c. In the results of such investigations, we all of us have something more than *microscopic* interest.

Another field for investigation which, to me, appears likely to be of great importance in its general bearing, has been recently reopened by Cohnheim, and urged upon the attention of microscopists in this country by Dr. Charlton Bastian. I refer to the relations between the blood corpuscles and the walls of the vessels,

and the passage, under certain circumstances, of the corpuscles through the unrent walls. The results of Cohnheim's observations and his theoretical conclusions, if established, might tend materially to modify our ideas as to the nature, if not as to the treatment, of certain of the phenomena of various ailments to which all of us are more or less liable. It is curious to note that similar observations to those of Cohnheim were made many years ago by Dr. A. Waller and Dr. Williams. But, as in other instances, reimportation from Germany has secured for these observations more attention than they received as native productions.

You will object, I fear, that all these subjects are more immediately interesting to myself than they can be to most of you. I forbear, therefore, to go on with my list.

I may, however, allude to a subject in quite another department, which is open to the study of all, and which sooner or later will, I think, assume a greater importance in its general bearings than is, perhaps, at the present time supposed. I refer to the influence which varying physical conditions exert upon *not-living* matter in its transition from the fluid to the solid state—in other words, and in illustration — the effects of temperature and moisture, and viscidity of solution in modifying the process of crystallization and the forms and structure of the resulting crystals. This subject has been already very ably brought before us by Mr. Hislop, and also by Mr Martin, on the part of Mr. Hookham, and I think we have good reason to hope that we shall soon be favoured with the results of the further observations and experiments made by these gentlemen.

I am naturally enough led on to another topic of the widest interest. It is needless to remind you of the almost unlimited field for research afforded by the myriads of plants and animals revealed to us by the microscope, but of the very existence of which, without the microscope, we should be ignorant. Everyone who has had the opportunity, must have felt a peculiar kind of fascination in watching the changes and movements of these tiny but wondrous organisms. Now, with regard to these organisms there appears to have been, and still to be a too great tendency on the part of microscopists to multiply species. But surely it is a better thing to do, to show clearly developmental or other relationship between two or more different forms, than simply to find some hitherto undescribed form, and give to it a new specific or generic

name. The complete life-history of almost every one of these microscopic living things—whether plant or animal, or neither one nor the other, but something between the two—has yet to be traced out and written. Much has been attempted. Something has been achieved. Much more remains to be done. Let me point out one direction in which experiment may usefully be brought to the aid of simple observation.

The influence of external circumstances on the development of the individual, and more remotely on the more or less lasting characteristics of the species, is a subject fraught with interest. It is one too which has of late engaged the earnest attention of students in every department of natural history.

Now, the living beings which especially come under the ken of the microscopist are of all others the easiest to watch throughout the whole period of their several existences. Their metamorphoses are speedy, their lives are short, and generation very quickly follows generation. Their external conditions may be controlled and regulated to a certain extent with ease. Temperature and light may be varied with some degree of accuracy. Food and atmosphere may be varied also, though perhaps with more difficulty. Surely in such case it must be comparatively easy to make out something as to the power of external circumstances to cause modification of the individual, and afterwards variation of the so-called species.

Thus, gentlemen, though I have not told you much of advances made, I have ventured to point out some few out of the many directions in which it seems to me there are some prospects of rich results to the able and industrious worker.

And now, in one way or other, I have been over the three stock subjects of "the Presidential Address." I venture however to trespass still further upon your indulgence.

There are at least two ways in which the cause of science may be promoted. First, something new may be ascertained; secondly, the knowledge of what has been already ascertained may be more widely spread. Now with respect to the progress of microscopical science during the past year, granting that no great discoveries have been made, yet it cannot be doubted that very many persons who before knew nothing of the use of the microscope have learnt something, and many more who knew a little have learnt much. The stream has not deepened perhaps, nor even has it advanced

very rapidly in its onward course; but assuredly the waters of knowledge have been spreading over a larger and larger area.

The microscope has now fully entered what may be called the third period of its general history. At first it was little better than a toy. It served to kindle wonder and to excite curiosity; and so far, perhaps, it was useful. But it failed altogether to satisfy the earnest student of nature. Correctness of interpretation could not be ensured until greater clearness of vision was obtained. In its next stage of development the microscope became an instrument of research of almost unrivalled value. By its aid discoveries of the greatest interest and importance were made in rapid succession. Fields for investigation hitherto unknown, but now found full of rich promise, were opened up. New departments of science were created. But though the harvest was rich, the workers were few; and these few for the most part were of those who devoted themselves more or less exclusively to scientific pursuits. Now however in this, the third period of its history, the microscope has come into much more general use. It is still the instrument of strict scientific research. In the hands of the few it goes on yielding results of increasing accuracy and truthfulness, and therefore of increasing value. It enables us to see clearly where before we had but dim glimpses. And thus it continues to aid us in our attempts to solve some of the deepest, and most intricate problems of our material being. But more than this, the microscope is now in the hands of the many. Its value is recognised in the instruction of the young. To the student of abstract science and to the man of letters, it affords a refreshing change of study and occupation; and the active man of business finds it a never-failing scource of amusement and recreation of the truest and best kind.

This consideration leads me to topics in which we are all interested—I mean the present success and future prospects of the Quekett Microscopical Club. It is said that the talk of lovers is so interesting because, with whatever subject they start, the conversation soon comes round to themselves. And thus we come round to speak of ourselves.

Well, gentlemen, I think we may most fairly and most heartily congratulate ourselves upon the position of our Club. We have been eminently successful thus far; and there is every prospect

of a still more eminently successful future before us. You have heard the Report just read. I need not offer any comment on the several items. Our numbers, our financial position, the attendances at our meetings, the interesting character of the discussions carried on, the establishment of our Journal—these and many other subjects alluded to in the Report, may, I think, be regarded with satisfaction by every one interested in the wellbeing of the Club. When the Quekett Microscopical Club was first projected, there were many who said that such a Club was not wanted, and would never find room. Such objections have been effectually answered and silenced by the signal success which has been so speedily achieved. Nay more,—we now hear expressions of regret, and even of surprise that our Club was not earlier started.

The success of any undertaking in which we are engaged may legitimately enough be considered matter for congratulation, on account of the personal satisfaction which such success affords us. But in the present case, I think we may congratulate ourselves on far higher grounds than those merely of pride and pleasure in the reward already gained, and the encouragement offered us to go on.

The success of the Quekett Microscopical Club affords incontrovertible evidence of an already wide spread, and still more widely spreading interest in the use of the microscope, and the study of its marvellous revelations. The fact of which we thus have evidence appears to me matter for congratulation, because I believe that the microscope is capable of affording very valuable aid in the great work of education. Allow me to ask you for a few minutes to consider the use of the microscope from an educational point of view.

You will at once understand that I do not now use the words education and educational in the restricted senses in which they are too often wrongly employed. School work and college work, as commonly accepted, together with the special studies preparatory for profession or business, really constitute but a small part of education rightly understood. In its full, broad sense, education implies the drawing out and developing, the strengthening and maintaining by exercise, the various faculties and powers with which we are endowed. It is a process which begins in our very earliest days, and goes on throughout our lives. We are often unconscious alike of its progress and direction; and we sometimes feel

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surprise when awakened to the results. In any study or pursuit there are two possible sources of advantage. There is, first, the practical utility of the knowledge gained, or the object attained; and secondly, the beneficial effect of the study or pursuit upon the mental or physical powers of the individual. The former may be considered as indicating in a certain sense the *commercial*—the latter the *educational*—advantage of the study or pursuit.

Now when we consider the subject from the point of view I have thus hastily and imperfectly indicated, it becomes easy to see how valuable an aid the microscope may be in the process of general education, and how much more widely than is often supposed it is capable of being rendered useful.

Allow me to offer you two or three illustrations of the educational aspects of the use of the microscope.

First,—with regard to the *Senses*. In the work of education, as ordinarily understood, no systematic attempt is made, so far as I know, to educate the faculty of observation. Attempts are made to strengthen the memory, to draw out and exercise the calculating and reasoning faculties, and to teach discrimination in the use of language. At any rate, school and college studies are commonly accredited as being attempts having such tendencies. But the observing faculties are too often left to take their chance—to be awakened by accident, and fostered and developed by fortuitous circumstances. The playground, the cricket field, and out-of-school occupations thus afford opportunities not supplied in the class room, or at the Professor's lecture. But systematic cultivation is needful for the production of the finest fruits and best results. The education of the observing faculties being thus neglected, naturally enough the importance of accurate observation is liable to be ignored. To the mere word-weaver, however clever—to the mere reasoner, however logical—the easy fictions of the imagination are apt to be as acceptable as the hard facts of observation. A most eminent logician and divine is said to have been a disciple of Hahnemann the Globulist; and a most distinguished mathematician has been believed to be an ally of Home the Spiritualist. There is nothing surprising in this. The study of mathematics and logic does not necessarily involve the cultivation of the powers of observation and investigation. But it is impossible that the well educated observer—the rightly trained investigator—could ever accept the absurd conclusions attributed to the acute logician and the ac-

complished mathematician to whom I have alluded. Readiness and accuracy of observation are likely to be of more service to most men in this work-a-day world than any amount of what is called scholarship, even together with the high development of the faculties especially cultivated in its attainment.

Now, when a man is at work with his microscope he is not only learning something about the object he may be examining, but he is educating and exercising, in various ways, his observing faculties.

In the first place, obviously enough, the microscopist learns to use his eyes. And the eyes themselves, if rightly used, and not abused, are thereby improved. The habit of seeing quickly, observing accurately, and discriminating minutely is insensibly acquired, or at any rate effectively cultivated. This habit becomes of the greatest service in every day life. As a man uses the dumb bells to develope his muscular powers, so he may use his microscope to develope his visual powers, and with an equal prospect of success. There is, however, this difference in favour of the microscope, that in using it knowledge is gained in addition to the advantage derived from the exercise of the sense of sight.

Again, the microscopist necessarily educates his sense of touch, and practises himself in the use of his hands. And how great a gain is this! What a difference there must be between the powers of manipulation of the novice who turns down his instrument till he smashes his object, and the experienced worker who at once easily and accurately focusses his one-fiftieth of an inch object glass. No one can become a successful microscopist without acquiring in a very high degree delicacy of touch, and lightness, accuracy, flexibility, and steadiness of manipulation. These same qualities are most useful in a hundred different ways. The value of an educated hand is not half appreciated, and yet from time to time we become practically sensible of it. Let me tell you an anecdote in illustration:—A gentleman calling one morning, earlier, perhaps, than he ought, found his surgeon doing some microscopical work—dissecting out, I believe, the pygidium of a flea. In reply to questions asked, the nature of the work was explained, and an attempt was made to excite interest in the object. The result was a somewhat contemptuous enquiry—"What good can it do a surgeon to dissect out the posterior parts of a flea?" Sometime afterwards the gentleman in question had occasion to avail himself of the services of his surgeon in a very painful and

somewhat serious malady. One day he said—"I can't think how it is, but your fingers seem to be very different to those of any one else; they go at once to the point; you remove the dressings, introduce the probe, re-dress the wound, and it's all over, almost without my knowing it—certainly without my being inclined or able to resist." "Do you recollect," said the surgeon, "laughing at me for dissecting a flea? Well, doing such work as that has taught me how to use my fingers. What would be fatal clumsiness in dissecting a flea is delicacy itself in operating upon you!"

It would be easy to multiply illustrations of the every day value of that facility of manipulation and delicacy of touch which the microscopist necessarily acquires in the pursuit of his investigations; but I forbear. Each of you, doubtless from personal observation or experience, could supply many illustrations. Do not forget them when estimating the educational value of the use of the microscope.

In the next place, with regard to the *Intellectual Faculties*, there are very many ways in which the use of the microscope affords opportunity for the development of the intellect. Speaking generally, it is obviously impossible to work honestly and industriously in any department of natural science without profitably exercising the intellectual faculties, in one way or other, to a greater or less extent. In all such labour there is profit. But to take a special illustration, the microscopist has not only to learn to observe accurately; he must also learn to interpret correctly. In observation the senses are especially called into play; but interpretation is essentially an operation of the intellect. Let the same object be placed before half-a-dozen observers, and let a full account be demanded from each. Within certain limits all will probably agree. Beyond such limits all may strikingly differ. As to what is seen there will be unanimity; but as to what is understood, there may arise the greatest differences. Such differences will probably be found to depend upon intellectual differences between the several observers.

In learning to interpret correctly, the microscopist has a fine field for the exercise of various powers of mind. He must learn to discriminate between what is seen and what is supposed; he must learn how far he may safely advance, and where he must pause.

The would-be discoverer is too apt to see a little, to imagine a great deal, and then to elaborate results which for the moment charm the fancy, but which are, as they soon prove, altogether baseless and unreliable. The microscopist must learn especially to

avoid seeking in his imagination what his observation fails to shew, and drawing thence conclusions which investigation fails to support. This lesson should be constantly before him; and surely it is a lesson that, if well learnt, must have good effect far beyond the limited domain of mere microscopical studies.

Lastly,—with regard to the *Moral Qualities*. It is needless for me to say anything respecting the general tendency of the study of any department of natural science to enlarge, to elevate, and to refine. It is equally needless for me to dwell upon the exquisite beauty, the infinite variety, and the almost boundless numbers of the objects revealed to us by the microscope, and the effect which the contemplation of such objects must have upon the thoughtful mind. Tongues and pens far more eloquent than mine, have found these topics fertile subjects for discourse. But permit me to remind you of one quality of which the microscopist is eminently in need, and which therefore he cannot help cultivating—a quality too, which stands a man in good stead over and over again almost every day of his life. I mean *patience*. No man can be a successful miscroscopist who has not a well-nigh inexhaustible fund of patience. In the collection, the preparation, preservation, and examination of objects how much patience is required! It is not enough for the microscopist to "learn to labour"—he must "learn to wait." Often and often it happens that an object upon which much time and much earnest labour have been spent must be laid on one side, and carefully kept and attended to from time to time for a long period before it is ready for examination. And if patience fails, the specimen is spoilt and time and labour are all but wasted.

I need say no more on this point. All of you who have been successful know by experience how much patience you have exercised. And those of you—if such there be—who have hitherto failed to achieve satisfactory results, where others have succeeded, will, I think, be ready to admit that want of patience may help to explain your failure.

Thus, then, gentlemen, I have ventured to offer to you a few remarks on the use of the microscope in its relation to general education. What I have said can only be regarded as suggestive, not as conclusive, much less as exhaustive on any one point. But I think I have said enough to justify our mutual congratulations on the success of our club, and the evidence this success affords of the growth and spread of a genuine and deep interest in the use of the microscope and the study of its revelations.

There is an old fable of a man who, dying, bequeathed his field to his sons, and told them that if they would but dig diligently they would find great treasure. The sons dug diligently—they found no hoard of gold as they expected, but the well dug field produced an abundant harvest. Thus the sons reaped the rewards, and acquired the habit, of persevering industry.

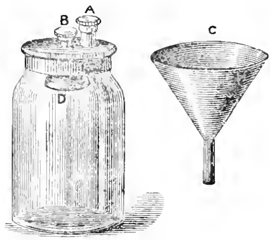
So the young microscopist may begin his researches, expecting to make some brilliant discovery. He may utterly fail to do so. And yet his work, if honest work, will not have been thrown away. He will have learnt much. He will have gained much that he did not seek—perhaps something more truly valuable than that which his first ambitious thought suggested. We cannot all of us be Queketts, Carpenters, or Beales, but every one of us can do something—we can advance ourselves, and we can help those around us. And if what I have said be true, everyone who works well with his microscope during such opportunities as he may have, cannot fail to become in more senses than one "a wiser and better man." He will learn to use his eyes and his hands; his faculties of observation will be educated; he will learn to interpret correctly what he sees; he will learn that fancies are not to be trusted, and that though the imagination may suggest, it can never justly take the place of observation; he will practice himself in patience; he will have ever ready at command an unlimited supply of objects, which can never fail at once to stimulate and to feed his interest, wonder, and deepest admiration.

And now, gentlemen, it only remains for me to express my sense of our very great obligations to the gentlemen of our Committee and of our several Sub-Committees, and especially to our indefatigable Secretary, Mr. Bywater. The thanks of all of us are due to these gentlemen for the able manner in which they have fulfilled their duties. My thanks are especially due to them for the unvarying consideration, and courtesy, and kindly feeling they have always been so ready to display in our mutual intercourse.

Gentlemen, I thank you all most sincerely for the patience and attention with which you have listened to me this evening.

NOVELTIES.

Wright's Microscopic Collecting Bottle.—This convenient contrivance has just been introduced by Mr. Wright, of 59, Shepherdess-walk, City-road, for the purpose of collecting and retaining the minute objects which may be floating, sparingly or otherwise, in water obtained by the dipping bottle. It consists of a bottle with a moveable cap, in which is cemented two tubes with screw tops. One of these projects an inch or more above the other, which is prolonged a little downwards, and has its mouth enlarged into a trumpet or funnel shape. Across the mouth of this a piece of fine muslin, or other more suitable porous material, is stretched. The loose funnel shown is placed in the mouth of the higher tube, and the water containing the organisms which it is wished to retain is poured into it. As soon as the bottle is full, the water rises through the porous material placed across the lower end of the inner tube, and runs off, leaving behind it and in the bottle the diatoms, desmids, entomostraca, &c., which may have been floating therein. Any quantity of water may thus be deprived of the minute objects floating in it, without the troublesome, imperfect, and destructive process of first filtering through a piece of muslin, and then reversing the filtering material in the mouth of the bottle, to detach the deposit.



For collecting larger objects, or placing plants, &c., in it, the cap of the bottle is made to take off.

Fiddian's New Eclipse Metallic Lamp Chimney and Shade.—Under the above name, Mr. Collins, of Gt. Titchfield-street, has introduced a substitute for the glass lamp chimneys, which we know to our vexation to be so easily fractured, at the very time when they are most wanted. It consists of a copper chimney, of the same shape as the ordinary glass ones, with a two inch aperture cut in the front of the globular portion. Into this opening is fitted a white or blue glass, with parallel surfaces. The inside is lined with white, so that an intense and pure light, the rays of which are parallel, is obtained. Perfect shade from all extraneous light from the eye of the observer, and freedom from the annoyance of broken glass chimneys, are among the advantages claimed for this contrivance.

QUEKETT MICROSCOPICAL CLUB.

JUNE 26th, 1868.

Arthur E. Durham, Esq., President, in the Chair.

The minutes of the preceding meeting were read and approved.

The following donations were announced :—

"Land and Water," from the Editor ; "Science Gossip," from the Publisher ; Paper "On Butterfly Scales," from Mr. Wonfer ; "The Naturalists' Circular," from the Editor ; fifteen slides of ferns, seeds, &c., from Mr. R. T. Lewis ; one slide of crystals of gold, from Mr. W. H. Golding, two slides from Mr. Curties ; and a slide of Navicula spherifera, from Mr. Kitton, through Mr. Hailes.

The thanks of the members were unanimously voted for these donations.

The following gentlemen were proposed as members of the Club :—Mr. James Wm. Groves, Dr. John Augustus Tulk, F.G.S., F.R.M.S., Mr. William Holmes, M.R.C.S., Mr. Fred. Rowland Jackson, Mr. James F. Wight, Mr. Edward Grubbe, C.E., Mr Robert Sewell, Rev. Richard Nathaniel Jennings, B.A., and Mr. James Rowe, M.R.C.V.S.

Thirteen gentlemen whose names had been proposed for membership at the last meeting were then balloted for, and subsequently declared duly elected.

The President announced that the next meeting would be the annual business meeting of the Club. The Secretary read the following names of gentlemen recommended by the Committee for election at the ensuing meeting :—

For President—Mr. Arthur E. Durham.

For Vice-Presidents—Dr. Braithwaite, Mr. M. C. Cooke, Dr. Dempsey, and Mr. T. C. S. Roper.

For Committee—Mr. T. W. Burr, Mr. F. W. Gay, Dr. Gray, and Mr. R. T. Lewis, and for re-election to fill vacancies, Mr. J. Bockett, and Mr. Ketteringham.

The Secretary read the following notices of alterations in, and additions to the laws, to be proposed at the next meeting :—

Rule 2—That the Editor of the Journal be *ex-officio* a member of the Committee.

That the four senior members of Committee shall retire annually, and shall not be eligible for re-nomination by the Committee, except for the purpose of filling vacancies, but may be nominated for re-election by independent members of the Club.

Rule 7—To strike out the words—" But that any member proposed for election after the 31st March in each year shall be exempt from subscription until the following July in each year."

And an alteration in Rule 9, respecting balloting papers.

The Secretary read the following notice of alteration in Rule 2, proposed by Mr. M. C. Cooke :—

That the remainder of Rule 2, after the words " shall retire annually," be struck out, and in place of them be added the words " but neither they nor any of them, nor more than two of the Vice-Presidents, shall be eligible for re-election."

Mr. Cooke asked leave to withdraw the first portion of his proposed amendment relating to the Committee, as the alterations proposed by the Committee met the case.

Mr. T. C. White and Mr. Suffolk were appointed auditors.

The following objects were announced for exhibition :—

Crystallised Silver, by Mr. T. Oxley; Coscinodiscus from Melville Bay, shown under a half-inch objective and binocular by Mr. H. Crouch; Tubules in the corium of the Crab, by Mr. Martinelli; Abdomen of Hoplia cærulea, by Mr. Marks; Pandorina Morum, from Leatherhead, by Mr. Hainworth ; Wing of Morpho Menelaus, by Mr. R. T Lewis ; and Foramenifera from the Phillipine Islands, by Mr. H. F. Hailes.

Mr. Cooke announced that he had received from Maine some Canada balsam, for trial by members, and from Schonbeck, near Magdeburg, six slides of slate, in reply to the circular issued by the Club ; also a number of slides for exchange from Herr Weissflog, and a hundred slides, also for exchange from Mr. Gould, of North Bridgton, Maine, U.S., principally consisting of diatoms, in sets of 14 each.

Mr. Cooke also exhibited a slide containing 400 diatoms, comprising 370 species, arranged in four squares, each one of which is referred to in a key. The slide was by Mr. Möeller, of Wedel, in Holstein, and duplicates might be obtained at the price of three pounds each.

The President noticed the presence at the meeting of Mr. W. J. Letsom, H.M. Chargé d'Affaires at Monte Video, and President of the Microscopical Society of Monte Video.

Mr. Hislop drew attention to four slides of crystals of sulphate of copper which he presented to the cabinet of the Club. The meeting was reminded of a paper on the subject read at a previous meeting, which described results which were not quite in accordance with those arrived at by the speaker. Specimens of these latter would be found in the slides presented. No. 1 exhibited very fine spirals, resembling a tuft of hair twisted in a spiral form. These were obtained at a low temperature. No. 2 was crystallised at a higher temperature, but here the spirals were lost and replaced by stars. Nos. 3 and 4 exhibited the effects of a still higher temperature, giving very beautiful circular crystals, with spiral striæ, resembling the striæ on a diatom. Mr. Hislop stated that he was continuing his experiments, and hoped to be able to add some further specimens before long.

Mr. J. A. Archer then read a paper " On Tobacco."

A vote of thanks was passed to Mr. Archer.

The proceedings terminated with a conversazione.

JULY 24TH, 1868.

ANNUAL MEETING.

ARTHUR E. DURHAM, ESQ., PRESIDENT, IN THE CHAIR.

The minutes of the preceding meeting were read and approved.

The following donations were announced :—

"Land and Water," from the Editor ; "Science Gossip," from the Publisher ; "The Popular Science Review," from the Publisher ; and the "Naturalists' Circular," from the Editor.

The thanks of the club were voted to the donors.

The following were the names of gentlemen proposed for membership :—Mr. Frank Crisp, Mr. Francis R. H. Heawood, Mr. Charles Atkinson, Mr. John Cousens, Mr. Y. Ducr, Mr. Alexander L. Donaldson, Mr. Charles J. Leaf, F.L.S., President of the Old Change Microscopical Society, and Mr. T. G. Rance.

The ballot then proceeded for the ten gentlemen whose names were proposed at the previous meeting, and who were afterwards declared duly elected.

The President then called upon the Secretary to read the following report of the committee for the past year :—

"Your committee have much pleasure in reporting that the success of the Club continues to advance, and that the keen interest evinced by the members in previous years has by no means abated during the year now brought to a close.

"The first among the many pleasing circumstances to which the committee would desire to draw attention is that the Council of University College have most liberally renewed their permission to the Club to meet in this Library during another year. This is a privilege well calculated to encourage and promote the objects for which the Society was originally instituted. It therefore becomes a boon for which the committee and members must be equally grateful.

"After considerable deliberation your committee succeeded in effecting such arrangements as have enabled them to commence the publication of a Quarterly Journal of Proceedings, and under the editorship of Mr. HISLOP two parts of the Journal of the Quekett Microscopical Club have been already issued. The committee trust that the form in which the Journal has appeared and the matter it has contained have been generally satisfactory to the members of the Club. It is hoped that the Journal may be the means of rendering absent members better acquainted with the proceedings of the Club, and so aid in promoting their co-operation in the cause of microscopical science.

The Committee cannot do otherwise than allude to the Soirée of the Club given in March last They feel that the success of the evening, and the gratification afforded to the members and their friends, were greatly due to the exertions of those of our number who contributed specimens for exhibition, or in other ways aided in carrying out the general arrangements.

The many interesting papers read during the past year are now more or less fully recorded in the Journal. It is therefore unnecessary to enumerate them here.

The number of slides now in the Cabinet amount to 700, the following additions having been received during the year:—

Anonymous	14	Mr. J. Meacher	1
Mr. J. A. Archer	5	,, W. Moginie	1
,, C. Collins	1	,, G. Potter	5
,, M. C. Cooke	250	,, T. Ross	20
,, T. Curtics	2	Capt. St. John	1
Dr. Dempsey	12	Mr. T. Simpson	8
Mr. W. H. Golding	13	,, H. A. Smith	14
,, H. F. Hailes	5	,, T. C. White	5
,, W. Hislop	4	America	14
,, F. Kitton	3	Germany	5
,, R. T. Lewis	25		
,, S. J. McIntire	26		437
,, J. Martin	3		

"By numerous donations and some purchases, various important additions have been made to the Books of Reference in the Library, whereby its capability of usefulness has been considerably extended.

"Your Committee have pleasure in recording the increasing success of the Excursions, which form so exceedingly important a feature in the working of our Club. It is hoped that the results which the Excursion Committee may be able to make known at the termination of the season will bring many interesting facts as to localities and habitats prominently before us, and thus stimulate members to renewed exertions, and lead to more methodical records of observation in the future.

"Your Committee have under consideration plans for affording members increased opportunities of meeting during the winter months for conversation, as well as for the exhibition of recent captures or other objects of interest. Such meetings are intended in some measure to supply the place of the Summer Excursions. Should the endeavours of the Committee to effect such an arrangement be successful, they have reason to believe the result will be most advantageous to the Club.

"Since the last Annual Meeting 133 gentlemen have joined the Club, and during that period 24 names have been withdrawn; a few in consequence of death, and others by retirement. Consequently the total number of subscribing members on the 30th of June is 382.

"The Committee cannot conclude their Report without expressing their thanks for the assistance so cheerfully rendered by Mr. Jaques as Librarian and by Mr. Ruffle as Curator. Their cordial thanks are also due to Mr. Lewis for his valuable reports; to Messrs. Arnold, Gay, Reeves, and Suffolk, the Excursion Committee; and to Messrs. Bockett, Hailes, Hislop, and Marks, the Exchange Committee.

"The Committee hope that the continued success of the Club will promote increased activity among the members, and that by fostering a unanimity of feeling and a uniformity of action they will enlarge its sphere of usefulness and more fully develope the many advantages which it offers."

June 30th, 1868.

Dr. Braithwaite moved that the report of the committee be adopted, printed, and circulated amongst the members.

The motion, having been seconded by Mr. M. C. Cooke, was put to the meeting by the President, and carried unanimously.

The Secretary then read the following report of the Treasurer :—

TREASURER'S REPORT.

June 30th, 1868.

RECEIPTS.	£	s.	d.
Balance in hand at last Audit	35	7	3
Subscriptions received from July 1, 1867, to June 30th, 1868	162	10	0
	£197	17	3

PAYMENTS.	£	s.	d.
Printing and Stationery	26	14	10
Postages	9	0	0
Advertisements	1	9	6
Attendants	2	12	6
Property purchased	19	5	1
Petty Expenses	11	0	8
Expenses of Soirée	39	7	6
Journal, Nos I. and II.—nett cost	26	6	5
Balance at Banker's	62	0	9
	£197	17	3

ROBERT HARDWICKE, Treasurer.

We, the undersigned, having examined the above Statement of Income and Expenditure, and the Vouchers referring thereto, hereby certify that the said Account is correct.

W. T. SUFFOLK,
THOS. C. WHITE, } Auditors.

The adoption of the report was moved by Mr. Watkins, seconded by Mr. John Hopkinson, and carried unanimously.

The alterations in Rule 2, proposed by the committee, and of which due notice had been given (*see Page* 112), were put, and carried unanimously.

Mr. Cooke's motion, that the words "and two of the Vice-Presidents" be added to Rule 2, was also put and carried.

The next proposed alteration was to strike out from rule 7 the words, "but any member proposed for election after the 31st of March in each year shall be exempt from subscription until the following July in the same year."

Some discussion on this proposition ensued, and eventually Mr. M. C. Cooke moved to substitute for the words proposed to be left out, the words "That any member elected in May or in June shall be exempt from subscription until the following July of the same year" This motion having been seconded was put and carried.

The next proposition for consideration was to omit "that the words on another paper" from rule 9.

This alteration was also put and carried.

Mr. Collins and Mr. Suffolk having been appointed scrutineers, the ballot for officers for the ensuing year took place, and subsequently the gentlemen nominated by the committee (*see Page* 112) were declared duly elected.

The President announced that the following objects were contributed for exhibition:—A specimen of galls on the Oak, by Mr. Martinelli; Iridescent colours on the wing of a Fly, by Mr. Marks; and an apparatus for Polarisation by reflection, by Mr. Bestall.

Mr. Cooke, the secretary for foreign correspondence, announced that he had received a circular from the American Microscopical Society of New York, expressing the Society's wish to be placed in communication with other societies. He also stated that he had received communications, together with lists of

specimens, from Professor Hyrtl, of Vienna, and from Dr. Leopold Kirchner, of Caplitz, and stating their wishes to exchange.

The President then delivered an address (*see* page 95.)

Mr. Watkins and Mr. M'Intire moved and seconded a vote of thanks to the President, which was carried unanimously.

Papers were announced for the next meeting by Mr. Moore and Mr. Martinelli; and the meeting adjourned.

AUGUST 28TH, 1868.

ARTHUR E. DURHAM, ESQ., PRESIDENT, IN THE CHAIR.

The President, on taking the chair, expressed his gratification at meeting the members on the commencement of another year's proceedings.

The minutes of the preceding meeting were read and approved.

The following names were proposed for membership :—Mr. Charles Cecil Capel, Mr. Arthur Robert Andrew, Mr. James R. Eddy, Mr. J. W. Spencer Warre.

Eight gentlemen proposed at the last meeting were then balloted for, and subsequently declared duly elected.

The following donations were onnounced :—

A new Collecting Bottle, from Mr. Wright; "The Catalogue of the Paris Exhibition of Insects of August, 1868," from Mr. R. T. Lewis; "The Naturalists' Circular," from the Editor; "Science Gossip," from the Publisher.

Thanks of the Club were voted to the donors.

The following objects were announced for exhibition:—

Wing of a Mosquito, by Mr. M'Intire; Foramenifera, from Dog's Bay, co. Galway, from Mr. Glover by Mr. Ruffle; a new Portable Dissecting Microscope, by Mr. Hooper; a new form of Collecting Bottle, by Mr. Wright; the Electric Spark from an induction coil, with magnesium terminals, shewn under the Microscope by Mr. Golding.

Mr. Martinelli read a paper "On the Tubules in the Shell of the Crab." The author of this paper recommended the use of hydrochloric acid, and also of heat, in treating the crab shell, in order to exhibit the tubules clearly.

Mr. Breese expressed his conviction that the use of either of these methods would destroy all appearance of tubules, and thought from the low power, used by Mr. Martinelli, that he could not be speaking of the same appearances described in a previous paper by Mr. Slade, which required a power of about 1300 to shew them.

This opinion was subsequently confirmed by the examination of Mr. Martinelli's specimens; and Mr. Slade thought that the cavities seen in them had been produced by dissolving out the lime.

Mr. Wright's collecting bottle was exhibited by Mr. Brain. The apparatus is described at page 111.

Mr. McIntire brought before the meeting the subject of the identity of the mosquito and the English gnat. Some time ago he felt much interested in the subject of mosquitoes, and through the medium of "Science Gossip," he had

asked whether there was any difference between the gnat and the mosquito, The answer given was (Vol. II., page 48) that there was good deal of difference. but he found in Kirby and Spence that the characteristics differ so little that it is difficult to distinguish them. This summer he had noticed numbers of a large description of gnat, and supposed that these were the creatures which were the cause of so many letters being written to the public papers. He believed it to be a fact that in some seasons the females, and in others the males, preponderated, and as it is the females only which bite, this might account for their being more troublesome at some periods than at others He exhibited a gnat wing under his microscope that night, which exhibited iridescence, it being mounted dry for that purpose. To extract the lancets, he found the best way was to put the head on a glass slide, and heat it over a lamp in a drop of turpentine. It was doubtful to him whether there were five, six, or seven lancets; but in the majority he had seen only six. He thought the irritation following the sting was generally caused by crushing the gnat before it had withdrawn its lancets. They were thus broken into the flesh, and caused much inflammation. He could see no apparatus for injecting poison into the wound.

Mr. Breese had the authority of Mr. McLachlan for asserting the complete identity between the gnat and the mosquito, and also for the fact that the size of the gnat was much increased in warm weather.

Dr. Braithwaite called attention to the fact that the term mosquito was but a family name, in which about 17 species were known, varying very much in size—one species from Australia not being half the size of an English gnat.

A Member from Woolwich had compared the species there found, and said to be the mosquito, with common gnats, and could see no difference, and, in fact, the same remark applied to species which he had received from New Zealand.

The President confirmed these remarks by stating he had received specimens from India, which did not differ from our own. He suggested that as high temperature favoured decomposition, it was possible that gnats and flies in the act of stinging might introduce animal matter in a poisonous state into the system. This would cause great and serious local irritation.

The President announced the excursion of the ensuing month, and stated that at the next meeting Mr. Slade would read a paper "On Preparing and Mounting Sections of Teeth and Bone for Microscopic Examination."

The proceedings terminated with the usual conversazione.

Annual Dinner.—On June 23rd, those members who are in the habit of attending the excursions, together with several other members of the Club, dined together at the Swan Inn, Leatherhead; the chair was taken by the President, Mr. Durham, and after the cloth was removed sundry toasts, loyal and complimentary, were duly honoured. The company, after a short stroll in the neighbourhood, returned to town by train.

THE JOURNAL

OF THE

Quekett Microscopical Club.

Notes on Preparing Sections of Bone and Teeth for Microscopical Examination. By J. Slade.

(Read September 25th, 1868).

The title of the paper which I bring before the Club this evening does not imply that I should occupy your time by recapitulating all that has been written upon so well worked a subject. As the minute structure of bone and tooth forms a part of the studies of every medical student as well as the general microscopist, it happens that these structures have received a larger share of attention than has fallen to the lot of other structures which build up the vertebrate animal. Hence it seems that we know a little more, or, at all events, can say a little more of such structures than of others.

Almost every object under the Microscope presents different appearances under different powers. Such appearances are to be carefully noted, and no structure can be said to be sufficiently studied unless it has passed through a series of examinations, with powers varying from 50 to 1,000 diameters.

Ordinary care in the preparation may be all very well for objects to be examined from with 50 to 100 diameters. More care is necessary for objects from 100 to 400, but for powers higher than this the delicacy of manipulation required in preparing, and the amount of time consequently consumed thereby, often taxes too severely the patience and time of men engaged in ordinary business.

Having employed myself lately in the endeavour to verify for my own uses some of the investigations detailed in Kölliker's

"Human Microscopic Anatomy," I have gained by successes and failures a certain amount of experience, which I now bring here in order to be criticised and discussed by any one who may have been at work upon the same subject.

Bone, under a power of from 50 to 100 diameters, shows the Haversian canals, with the bone in laminæ surrounding them; under 200 or 300 diameters, that which appeared before merely as black specks, turns out to be the spaces with radiating lines known as "lacunæ" and "canaliculi." These lacunæ and canaliculi vary in size and form, and are in a general way characteristic of the group of animals to which the specimen may belong. Dr. Carpenter has in his "Manual" given measurements of examples taken from each group of the vertebrata.

Under from 400 to 600 diameters a cell, with clear contents, and a nucleus, is seen exactly filling the lacunæ, and sometimes even running up the canaliculi for a short distance.

All bone we know to be either ossified cartilage or membrane, the nucleus of the lacunæ is the nucleus of the previously existing cartilage cell. As membrane has no definite structure like cartilage, I once thought that a microscopic distinction might be detected in the completely-formed bone; but, after several experiments, I could find none, and Kölliker states that there is none, and that previously to ossification taking place in a membrane, plasma cells are produced, the nuclei of which form the nuclei of the lacunæ. Kölliker also states that the cells of the lacunæ may be detached as separate stellate cells by treating a section with dilute hydrochloric acid, and then for a moment boiling in dilute caustic potash. I have tried this, but failed; nor have I yet been able to detect the ultimate osseous granules of bone mentioned and figured in the article on bone in the "English Cyclopædia."

With respect to the preparation of bone for Microscopic examination, the operation is not difficult. Thin sections, well polished and mounted dry, are usually considered best, but I prefer that method described by Dr. Carpenter in his "Manual," page 702, in which thick Canada balsam is used. If this method be properly carried out, the lacunæ and canaliculi come out beautifully defined, even those of the deep-seated cells. The drawback is that the balsam may run in and obliterate some of the cells situate at the edge of the specimen. But if injury should thus happen to a section, chloroform will speedily restore it to its original condition.

All fossil bone that I have tried requires Canada balsam; indeed, some of it is so very friable that it requires to be treated according to Mr. Newton's process, described in the "Naturalists' Circular" for September, which consists in soaking the specimen in Canada balsam, largely thinned by chloroform, before it is roughly cut in pieces preparatory to grinding down. Some specimens of Ichthyosaurus must be treated thus, whilst Pterodactyle is brittle and transparent, so that this method would obliterate the very delicate canaliculi. The finest example of fossil bone which I possess was the result of an experiment on a specimen of Coccosteus oblongus, an old red sandstone fish from Caithness. In examining a specimen split from one of those water-worn pebbles, which frequently form the bed of a mountain torrent in the Highlands, I detached a fragment with a knife's point, about the size of a pin's head. This I soaked in turpentine and mounted in fluid balsam; this rendered the fragment somewhat transparent at the edges, and I saw the lacunæ and canaliculi completely injected with a fine red material, rendering the finest of them beautifully defined.

The scales of Lepidotus from the Wealden are soft and opaque, and require great care, but show lacunæ exactly resembling those of the living Lepidosteus. The bone of Dinornis differs in nothing from recent bone, excepting the loss of the animal matter.

Another form in which calcareous matter is found to exist in the animal body, is in the organs known as teeth. Here, in all mammalian animals, it exists under three conditions, viz., enamel, dentine, and cement.

A section of human tooth mounted in the ordinary way in Canada balsam, under a moderate power, shows these materials easily enough. The cement,—partaking, more or less of the character of bone;—the dentine, or ivory, as fine, undulating tubes;—the enamel also in parallel tubes, but evidently of a much denser and firmer texture.

Under a high power the enamel is seen to consist of hexagonal prisms, packed closely together. The dentine is seen as tubes running through a matrix; the matrix itself, under the highest powers, is structureless. Upon the table is the tooth of the horse and one of the elephant, and the jaws, with the teeth entire, of a Cestracion, or Port Jackson shark.

The two former show distinctly, even as hand specimens viewed with a lens, the three component materials—enamel, dentine, and

cement. For microscopical examination, sections can be reduced thin enough without difficulty, as the hardness, combined with some amount of elasticity, renders them easily manageable. And by mounting in Canada balsam, but little of the structure is lost, excepting, perhaps, the lacunæ and canaliculi of the bone cells in the cement.

Of all the fossil mammalian teeth with which I have any experience, that of the Megatherium is the most troublesome from which to obtain fair results. The coarse vascular dentine, which forms a large proportion of the tooth, crumbles away readily, even after repeated macerations in fluid balsam.

The sections, mounted dry, and sold under the name of tooth of ant-eater, and showing a structure unique for mammalian tooth, are sections of a molar of the Aard-vark, or *Orycteropus Capensis* —an animal belonging to the class Edentata, common in some parts of Southern Africa, and occasionally known as the Cape ant-eater. The armadillo, belonging to the same order as the preceding, has small, simple teeth, composed of enamel, dentine, and cement.

For the elucidation of the ultimate structure of fish teeth, much remains to be done, and a hasty glance over the plates in Owen's "Odontography" and Agassiz's "Poissons Fossiles," awakens the microscopist to a mine of research by no means exhausted.

Fish teeth are of two kinds—sharp and pointed, fitted for tearing prey; and flat, broad, and rounded, close set, like pavement, fitted for crushing up mollusks and crustaceans. A good example of this latter is the Cestracion lying on the table.

If we examine microscopically a number of specimens of both kinds, we find them in the majority of cases to consist of dentine, permeated by vessels which gradually diminish in size towards the extremity of the tooth.

In others the vessels are absent, the substance being entirely dentine; external form being no guide to internal structure.

As examples of pointed teeth of vascular structure, we may take Galeus, cod-fish, pike (recent), Lamna elegans, Oxyrrhina, Galeocerdo, and Hemipristis (fossil). As examples of broad, crushing teeth of vascular structure, we may take Myliobatis (recent), Ætobatis, and Ptychodus.

Of the non-vascular dentine, we may mention the fossil genera, Sphœrodus and Lepidotus. Some there are, such as the recent Lepidosteus and the fossil Dendrodus, which from the replications

of the layers of dentine, form elegant patterns when seen in section.

From their comparative softness, fish teeth can be readily reduced upon a common grindstone and hone, to a degree of sufficient thinness for examination. Even the fossil ones may be treated in the same way with success. But by slicing thick ones, such as Ptychodus, Cochleodus, Myliobatis, &c., on a lapidary's wheel, much labour and material are saved.

Both recent and fossil specimens may be mounted in Canada balsam. Some of the recent are evidently improved by first staining them in carmine, and some mounted in glycerine show the vascular system beautifully distinct.

At the close of the paper the President observed that he had paid a good deal of attention to the Microscopic structure of bone, and could not admit that the best method of preparing such was by grinding down. In his opinion, this method in many cases filled up the cavities with *débris*, and thus obscured much which ought to be seen. Under favourable circumstances, it might perhaps answer for dry bones, where the form of the lacunæ and canaliculi was all that was required. But if we take a fresh bone, and with a strong, sharp knife cut off a very tiny slice, which could be easily done, and then immerse it in carmine dissolved in ammonia, the ammonia being first neutralised by acetic acid, the walls of the vessels which penetrate the lacunæ and canaliculi are by this means stained crimson, and thus the true structure of bone is rendered visible.

On a New Melicertian and Some Varieties of Melicerta Ringens. By J. G. Tatem,

Of the Reading Microscopical Society.

Some years since, a friend submitted to my examination a Melicertian, which could not be assigned to any known genus. Drawings were carefully made at the time, with the aid of the neutral tint reflector, and copies of these I now beg leave to lay before the members of the Quekett Club.

It will be seen that the new rotifer bears a general resemblance to *Limnias ceratophylli*, from any close alliance with which, it is, however, removed, by a higher type of organisation. A viscid sheath, to which excrementitious and extraneous matters adhere, equally characterises this species and Limnias; but it is slightly curved and more contracted at the base. The rotary disk is bilobed, a double wreath of cilia surrounding its margin. Two well developed water vascular canals or siphons, conspicuously prominent when the animal is seen emerging from its sheath, would indicate a nearer structural approximation to Melicerta than to Limnias, in which these organs are altogether wanting. The pharyngeal bulb also bears a close resemblance to that of Melicerta. Length of sheath $\frac{1}{75}$; of extended animal, about $\frac{1}{55}$.

In the Quarterly Journal of Microscopic Science (1867, p. 14), Mr. Davis described a rotifer under the name of *Œcistes longicornis*, which appears to be nearly allied to the one now described and figured, which that gentleman felt a difficulty in consigning to any recognised genus, and while calling it an Œcistes, and noting its resemblance to Limnias, evidently considered it as belonging to neither. Should it not rather have been brought forward as the type of a new genus, in which the Tubicola I figure would have found its place? While, therefore, for the purpose of artificial classification, venturing to constitute a new genus for their reception, for which the name of *Limnioides* is proposed, and the specific one of *myriophylli* for that now described, I would yet enquire if many of these animals are, after all, so generically distinct? Whether through variability such connecting links may not eventually be met with as to afford reasonable grounds for suspecting an insensible graduation into each other? Found on *Myriophyllum spicatum* and *Ranunculus aquatilis*, associated with *Melicerta ringens* and *Cephalosiphon Limnias*, the idea not unnaturally pre-

sents itself; and if I shall not be considered too much infected with Darwinian doctrines, I would hazard the assertion that these three species, together with Limnias, have but one common origin. Traced downwards from *Melicerta ringens*, through its varieties (drawings of some of which are laid on the table for comparison with the connecting link which the subject of our notice supplied), it will be seen that by easy stages of degradation, through arrest of development or suppression of parts, *Limnias ceratophylli* will at length be arrived at.

In the variety of Melicerta, No. 1 *(Fig. 2, pl. 7)*, we have an animal, though otherwise perfect, in which the cup-like rotary organ, which, for the sake of expressive phraseology, we will call the "Pug-mill," is wholly wanting. It results, therefore, that unable to mould pellets and construct the neat wall of masonry of Melicerta proper, it is invested only with the ordinary amber coloured gelatinous secretion.

In variety No. 2 *(Figs. 3 and 4, pl. 7)*, a further arrest of development has taken place; the four-lobed rotary disk of Melicerta is, though still ample, reduced to two, and without "Pug-mill," only rudely shaped excrementitious masses adherent to the gelatinous investment are observed.

In the third variety *(Fig. 1, pl. 7)*, these conditious of degradation are still more advanced—no "Pug-mill," an undivided ciliary organ, and but a single siphon.

Passing by *Limnioides myriophylli (Figs. 3, 4, and 5, pl. 6)*, which we have already endeavoured to connect with Melicerta, we come to *Cephalosiphon Limnias (Figs. 6 and 7, pl. 6)*, with two smaller rotary lobes and single siphon, which may possibly be formed by the coalescence or soldering together of two siphonal tubes into one long conspicuous canal, with a much contorted viscid sheath, coated with extraneous substances; and, lastly, we descend to *Limnias ceratophylli (Figs. 1 and 2, pl. 6)*, with two small lobes and water vascular canals wholly suppressed.

DESCRIPTION OF PLATES.

Plate 6, Fig. 1 & 2, Limnias ceratophylli ... ... × 100
Figs. 3,4,5, Limnioides myriophylli ... ... × 190
Figs. 6 & 7, Cephalosiphon Limnias... ... × 100

Plate 7, Fig. 2, Melicerta ringens... Var. No. 1 × 190
Figs. 3, 4... Var. No. 2 × 100
Fig. 1 ... Var. No. 3 × 100

On the Proboscis of the Fly. By B. T. Lowne, M.R.C.S.

(Read November 27th, 1868.)

The Proboscis of the Blow-fly *(musca vomitoria, Linn.)* is one of the most complex and remarkable structures in the insect world. It is composed of a chitinous frame-work, or skeleton, invested in a loose membranous integument, moved by a complicated system of muscles, and largely supplied with air by numerous tracheal tubes.

The skeleton consists of parts homologous to all those usually found in the mouths of insects, but some are so modified as only to be recognised by studying other Diptera, and then, in order to appreciate their true relations, it is necessary to examine specimens which have not been subjected to pressure, but which have been mounted with all their parts in their natural relations to each other.

Nearest to the oral cleft, and occupying the upper half of the proboscis, is a large shuttle-shaped piece, serving for the attachment of numerous muscles, exsertors, and retractors of the whole organ, as well as semi-circular fibres enclosing the œsophagus;—which lies in front of—but in immediate contact with—the posterior portion of this piece, which is hollowed out to receive it above, and which completely surrounds it below, forming a corneous tube for its protection. This may fairly be considered homologous to the fulcrum in bees, or it may be looked upon as the mentum.

Partially surrounding this, but closely connected with the integument, are two semi-circular bands of chitine, each bearing six to eight stiff setæ; they support the large maxillary palpi, and represent the basal lobes of the maxillæ of bees, the comb of which is replaced by setæ in the fly; lower than these, and supported by them are two thin, shield-like plates, covered with minute bristles representing the small inner maxillary lobes of the Hymenoptera.

These parts with their muscles enclosed in a loose integument form the basal joint of the proboscis; when at rest this is withdrawn into the oral cleft, the fulcrum then rests in the cavity of the head, and the membranous integument which is attached round the oral cleft forms an inverted funnel, as far as the insertion of the

maxillary palpi, the remainder of the proboscis lying within the cavity so produced.

When the proboscis is at rest or retracted, the maxillary palpi lie close to the margin of the oral cleft, directed forwards, but when it is fully exserted, they are turned upward in contact with its integument. As they are not apparently supplied with any muscles, and from their position during exsertion of the proboscis, appear as if turned out of the way of injury, this would indicate that their function is called into activity during the period when they lie along the margin of the oral cleft, so that it seems probable they assist the insect in its search for food; in fact, their position is the same as that of these organs in the Lepidoptera, except when the proboscis is exserted.

The second joint of the proboscis encloses two tubes; the anterior of which forms the termination of the œsophagus, and consists of parts homologous to the epiglottis and mandibles. This tube is connected with the fulcrum by the membranous œsophagus, and forms an elbow-like joint protected from pressure behind by a small semi-circular chitinous piece homologous to the mentum, or accessory to it, if the larger portion which I have named the fulcrum be considered as the homologue of that part.

The mandibles are further connected with the basal part of the proboscis by a pair of levers, nearly a line in length, flattened out at their upper extremity for the insertion of powerful muscles, and strongly suggestive of the elongated tendons by which the mandibles of insects are usually moved. Their action appears to be to move the œsophageal tube, raising it slightly from the labium against which it lies; as well as to assist in folding the proboscis.

The posterior tube is homologous to the labium and labial palpi; it is complete above, but open in front below, partially enclosing the œsophageal tube. It terminates in a triangular opening between the lips of the proboscis, which are supported upon its margin. In the embryonic or pupa state, this tube is represented by three distinct rods, clearly homologues of the labium and labial palpi, the second and third joints of the palpi being represented by the margin of the triangular opening, so that the lips themselves may be considered appendages of the labial palpi.

Behind the labium are the terminal lobes of the maxillæ; in the young state these may be seen to be composed of two layers, an inner membranous layer, largely supplied with air tubes, and an

outer chitinous structure developed upon it. These are permanently separated, in such insects as Tabanus, in which the outer layer forms a sheath for the lancets, and the inner alone enters into the structure of the proboscis. In the blow-fly, both layers are united in the adult insect, and give attachment to the muscles which move the lips; they terminate in long processes twisted at their junction with the maxillæ in such a manner as to form springs, which keep the lips of the proboscis closed when at rest; a powerful muscle is inserted into them, which overcomes their elasticity, and opens the lips, adding another to the already numerous known instances in which elasticity is opposed to muscular force, where prolonged muscular action would otherwise be necessary.

Perhaps I may be excused if I here mention two or three well-known but important facts. Insects are supplied with a circulation of air just as vertebrates are with a circulation of fluids, and although I do not deny that the fluids of insects circulate, their circulation is exceedingly imperfect and very sluggish. Now the tracheal tubes of insects are by no means permanent in every case, rapidly growing structures are supplied with an immense number of tracheæ, which disappear a few hours after their appearance, when the structures they supply are fully developed. Secreting and excreting organs are permanently supplied with a large number of tracheal tubes, but the number varies according to the activity of the organ.

When the fly first emerges from the pupa, none of the muscles of the proboscis are developed, nor are any of the chitinous structures hardened or opaque; the proboscis is filled with a milky corpuscular fluid, from which these parts are developed, it is then largely supplied with tracheæ, and hangs down, as the insect is quite incapable of moving it. In an hour or two the muscles are developed and the insect retracts the organ, soon after its wings are sufficiently dry to enable it to fly away. Most of the tracheæ of the proboscis disappear as soon as the chitinous parts are hardened.

Tracing back the œsophagus it will be found to bifurcate after entering the thorax, one division passing upward and backward into a muscular proventriculus and so into the stomach, the other passing backward along the under surface of that viscus enters the abdomen, near the base of which it opens into two large abdominal crops, which, when filled with fluid, occupy nearly half that cavity.

The abdominal crops are strongly muscular, and it is from these that the copious saliva is poured with which the insect moistens its food. The position of these crops is a marvellous instance of adaptation, for the fly's head is exceedingly heavy from the size of its eyes and optic ganglia, as well as from the number of muscles moving the proboscis, so we find the abdominal stomachs balancing the weight of the head by acting as a counterpoise behind the wings.

By examining the labium it will be found that its superior extremity is prolonged, behind the joint of the proboscis, to about half a line above the lower extremity of the fulcrum as a flexible tube, which widens out at its upper part, so as to represent in some degree the form of the human glottis and trachea. A large tracheal tube, marked with a stronger spiral than any other in the tracheal system of the head or thorax of the blow fly, terminates in it, and if this be traced back, it will be seen to traverse the head, and entering the thorax, to divide into two branches, each portion passing outward into a sacculus, communicating with the main lateral tracheal system of the insect.

I may here remark that the tubes forming the tracheal system of the abdomen, differ from those of the head and thorax very considerably, not only in general arrangement, but also in the much greater distinctness of the rings with which they are marked.

The air tube which surmounts the labium, opens upon its anterior surface, near the middle of that organ; the air so conducted through it passes to the triangular opening between the lips of the proboscis, in a tube *(labial tube)*, bounded behind and laterally by the labium and labial palpi, and anteriorily, partly by membrane and partly by the œsophageal tube, which opens into it just above the triangular aperture.

The lips of the proboscis, when at rest, are closely applied to each other; their outer surface is rough and covered by numerous long curved hairs, but their inner surface is smooth and soft, covered with a yellow pigment, which washes away in water a short time after the death of the fly; these inner surfaces exhibit the so-called false tracheal tubes.

When the organ is treated with liquor potassæ and afterwards mounted in balsam, the false tracheæ appear to he imperfect on their cutaneous surface, having a dentated margin; as far as the chitinous element is concerned this is really the case, and in the lips of

the fly, in the pupa state, this is even more apparent. In the early stages these tracheæ are only indicated by transverse lines in a flat membrane, the edges of which curl over as the insect approaches maturity; but in the adult fly, if the recent lips be examined, it will be found that the tubes are covered by broad bands of tissue, having a sinuous margin, and refracting light powerfully. By examining the pupa proboscis, these will be seen to be reflected from the margins of the false tracheæ, leaving an exceedingly minute fissure along the mesial line, on each side of which, lateral fissures extend at right angles across the tracheal tube, one corresponding to each dentation in the trachea itself. These fissures are so minute, that it requires a quarter-inch objective to show them clearly. They probably serve to allow air to pass to and from the false tracheæ, but do not allow fluids to pass into them, a fact I have demonstrated by feeding flies with coloured syrup.

During the life of the fly, the lips of the proboscis are not usually opened to more than two-thirds of their extent; this is effected by the muscles attached to the thin extremities of the maxillæ, which are then drawn at right angles to the remainder of the maxillary lobe, (the combined inner surfaces of the lips, in this position, form an oval sucker, reminding one somewhat of the sucker of Remora,) communicating through the fissure between the lips, with a cavity *(labial cavity)* bounded behind by the triangular opening of the labial tube, and in front by the remaining third of the lips. The false tracheæ open directly into this cavity, and are so connected with the labial tube, and through it with the whole air system of the insect. If the lips be examined by the aid of a Leiberkuhn in the living fly, whilst sucking in a live box, which may easily be accomplished by moistening the thin glass with a very small quantity of syrup, and allowing it to dry, it will be seen that the sucker formed by the combined lips is closely applied to the glass at its edges. That the fluid previously poured by the insect upon the sugar is drawn into the sucker by the exhaustion of the air through the false tracheal tubes, seems most probable, from their connection with the tracheal system.

Any one may convince himself that the readiest manner of extracting the sweet fluid from moistened sugar is by drawing air through it; so we see Nature has provided these insects with a special organ for overcoming capillary attraction, by calling in the aid of atmospheric pressure. I think it is probable that the œso-

phageal tube acts as a valve, closing the opening in the labium, by which the labial tube communicates with the large tracheal duct, before mentioned, for although this has not been demonstrated by me, its form and position would enable it to act in that manner, and if such be the case, the labial cavity and tube, as well as the cavity of the sucker, would continue to draw in fluid as long as the valve remained closed, a single exhaustive effort on the part of the insect enabling it to maintain suctorial power for some seconds.

A kind of rhythmic muscular action of the lips assists the ascent of the fluid into the labial tube, from which it is drawn by the open corneous œsophageal tube.

Gleichen long ago noticed the copious escape of air from the opening between the lips of the fly's proboscis, when the body of the insect is subjected to pressure; he supposed that its purpose was the inflation of the whole organ, which he considered as an erectile one. It is a curious coincidence, that I thought the same thing myself when I commenced the investigation of the subject, substituting a fluid for a gaseous agent, and expected for a long time that I should discover a special contractile sac for effecting this. I can confidently state now, however, that nothing of the kind happens, and that the exsertion of the proboscis is entirely a muscular act.

Within the labial cavity, and inserted into the triangular opening of the labial tube, are two rows of rods, bidentate at their extremities. I had never been able to make out their import, until Mr. Suffolk informed me that he has examined sugar on which flies had been feeding, and that it was striated with lines which, when measured by a micrometer, corresponded exactly to the distance between these teeth. I have never observed this myself, but can account for not having done so, as I have always used young flies, which are plentifully supplied with fluid in their abdominal crops with which they melt the sugar; in these the labial teeth are comparatively soft. I can quite understand that when the abdomen is heavy with the developed ovaries, or testes, that the abdominal stomachs are comparatively reduced, then the labial teeth, hardened, like all the chitinous structures, by age, would afford powerful auxiliaries to the solvent action of the saliva. They would be brought into play by the opening of the fissure between the lips, for which a special muscle is found on either side.

Another set of organs is found upon the inner surface of the

lips ;—minute papillæ, disposed in rows of from two to four, one row being placed between each pair of false tracheæ ; these are exactly similar to those described by Dr. Braxton Hicks in the " Linnean Transactions," as existing on the palpi, about the halteres of flies, and in other parts of insects—only much larger. I have found a considerable number of precisely similar papillæ just within the vulva of the female fly. They are undoubtedly organs of sensation, and although I have not succeeded in tracing their nerve supply at present, I do not despair of doing so.

In Mr. Topping's beautiful preparation of the fly's proboscis—which I have always looked upon as a marvellous success—it will be seen that the chitinous envelope is perforated for the passage of these organs. I thought at first they might be ducts, and that the interior of each lip contained a gland ; such could, however, hardly be the case, for its internal supply of air is effected by a minute branch, from the trunk supplying the maxillary muscles, which, on entering the lip, divides, half running forwards and half backwards, and gives off a few exceedingly minute filaments, a supply of air not at all adequate to a secreting structure.

The interior of the lips seems to be occupied by a few longitudinal muscular fibres, and by a network of fibrous tissue, which supports the false tracheæ from behind; this is best seen by inflating the lips, when it gives the interior of the organ the appearance of erectile tissue ;—during life, the lips are never inflated in this manner.

THE EXCURSIONS OF THE PAST YEAR.

THE endeavours of the Quekett Club to profit by the experience of field Clubs, and to establish a series of excursions in the neighbourhood of the metropolis, for the purpose of collecting objects of microscopic interest, appear to have met with considerable success. Some exceedingly pleasant meetings have taken place. A large number of specimens have been collected, and members desirous of studying natural objects in their own habitats have learned much. It is probable that if a record were kept of species, with the locality in which they were found, time of year, and any other particulars of interest, some important facts might be discovered. Although new species might not have to be recorded some rare ones might be obtained, and others thought to be rare and local might be shown to be more widely distributed. Comparative abundance or scarcity in different years, or at different times of the year, might also be noticed, and would prove not unimportant data for future consideration. Alteration in climate or condition of the soil, as affected by drainage and other circumstances, would be observed in their effects on the delicate organisms which are known to us through the microscope.

With the view of registering these facts for future reference, we propose from time to time to insert lists of species, and localities established for them at these excursions. It would also materially assist our object if individual collectors would also make notes of their observations, and forward them to us for incorporation in our lists.

SPECIES COLLECTED, WITH THEIR LOCALITIES.

APRIL 4, 1868. HAMPSTEAD PONDS.

Day mild, genial, and sunny.

Conochilus volvox (abundant)
Volvox globator (ditto)
Micrasterias rotata
Euastrum oblongum
Closterium lunula
——— turgidum
——— striolatum
——— acerosum
Cosmarium margaritiferum
Pandorina Morum
Coleochæte scutata

Chætonotus larus (abundant)
Actinophrys sol
Rotifer vulgaris
Hydra viridis
Stentor Mulleri
Epistylis anastatica
Carchesium polypinum
Melicerta ringens
Floscularia ornata (abundant)
Various larvæ and the common entomostraca in abundance

Dr. Ramsbotham sends us the following:—

"A *Volvox globator* becoming partially entangled amongst some confervæ, I had an opportunity of observing that which I had never seen before, viz., that the young organisms within the parent globe, on moving in various directions, propelled some of the minute green spots beyond the circumference of the sphere; they were again attracted and again repelled, when by an apparently stronger push one or two were entirely separated, and sent afloat, gradually disappearing from view."

Mr. Ward remarks:—

"One *Volvox* of about $\frac{1}{40}$ in. diameter contained six smaller ones each about $\frac{1}{160}$ in. There was an aperture in the parent cell-wall through which I saw four of the six escape in quick succession. Each one took some few seconds to get through, as the opening seemed exactly as large as the spheres, and as soon as the way was clear another presented itself at once. The two last, though revolving freely, never made an attempt to pass through whilst I watched them. A second *Volvox*, of larger size, but with smaller internal globes, contained a foreign body (from the outline I thought a dead rotifer). With a high power I could distinctly focus front of cell-wall, then this body, and lastly back of cell. I could detect no aperture, however, in the cell."

In addition to the foregoing list of aquatic organisms Dr. Braithwaite collected the following mosses and hepaticæ, dried specimens of which he has presented to the Club:—

Sphagnum cymbifolium
——— acutifolium
Pleuridium subulatum
Dicranella heteromalla
Dicranum scoparium
Pottia truncata
Ceratodon purpureus
Barbula muralis
Funaria hygrometrica
Webera nutans
Bryum capillare
——— argenteum
Atrichum undulatum
Polytrichum commune
Polytrichum piliferum
Brachythecium albicans
——— velutinum
——— rutabulum
Eurhynchium prælongum
Hypnum cuspidatum
——— stramineum
——— fluitans
——— cupressiforme
Jungermannia albicans
——— inflata
——— divaricata
Lophocolea bidentata
——— heterophylla

April 18. Barnes Common.

Various larvæ and entomostraca were collected from the large ponds. In small pools behind the Cemetery were found *Conochilus*

volvox, sparingly; *Volvox globator*, fine and abundant; *Æcidium Ranunculacearum* was found in Roehampton Lane.

The mosses collected by Dr. Braithwaite, specimens of which have been presented to the club, were as follows:—

Pleuridium subulatum	Pogonatum aloides
Weissia cirrhata	Hypnum cuspidatum
Physcomitrium pyriforme	——— illecebrum
Webera nutans	——— purum
Bryum cæspiticium	Lophocolea bidentata
Aulacomnium palustre	——— heterophylla
Philonotis fontana	Jungermannia bicuspidata
Polytrichum commune	Pellia epiphylla
——— juniperinum	Radula complanata

In a ditch running eastward from the large pond *Vorticella microstoma* was found in great abundance, adhering to *Anacharis* in gelatinous masses; also *Ophrydium versatile*, embedded in a globular gelatinous cyst of a pale green colour, measuring from one to two inches in diameter, and swimming freely. Each ophrydia is stated to be from $\frac{1}{100}$ in. to $\frac{1}{120}$ in. in length, so that a cubic inch would contain eight millions. The entire mass is sometimes as large as a man's fist.*

May 16. Chiselhurst.

By kind permission of Mr. Wollaston much time was spent in viewing his beautiful garden,containing several hundred varieties of ferns. *Æcidium viola*, *Melicerta ringens*, and *Volvox globator* were obtained from the ponds.

May 30. High Beech.

In consequence of the heat all the pools were dried, and nothing was collected but *Chara translucens* and another unnamed species of *Chara*, supposed to be new.

June 13. Northfleet.

The most interesting object obtained on this occasion was the Æsop shrimp, *Pandalus annulicornis* in its larval state. It was found in some quantity in one of the ditches near the railway station.

* See Micrographic Dictionary.

We are indebted to Mr. Simson for the following list of diatoms, found in these marshes. He remarks—"I feel confident that I shall ultimately be able to record at least 50 species from this prolific locality."

Bacillaria paradoxa	Pleurosigma attenuatum
Achnanthes brevipes	——— Balticum
Actinocyclus undulatus	——— delicatum
Amphiprora alata	——— fasciola
Biddulphia aurita	——— Hippocampus
Cocconeis scutellum	——— littorale
Coscinodiscus eccentricus	——— quadratum
——— lineatus	——— scalprum
Melosira nummuloides	——— Grevillii
Navicula Amphisbæna	Surirella Brightwellii
——— didyma	——— gemma
——— punctulata	——— ovata
——— Smithii	——— striatula
Nitzschia dubia	Synedra tabulata
——— sigma	Tryblionella acuminata
Pleurosigma acuminatum	——— marginata
——— angulatum	

July 4. Keston Common.

Batrachospermum moniliforme, and a few desmids were found. The bogs were very nearly dried up.

July 18. Esher.

Very little of microscopical interest was found at this excursion, owing to the very dry weather. Mr. Reeves gathered *Senebiera didyma* and *Pilularia globulifera* on the common.

August 1. Hampton Court.

Cristatella mucedo	Actinophrys Sol
Limnias ceratophylli	——— Eichornii
Œcistes crystallinus	Anthophysa Mulleri
Lacinularia socialis	Difflugia ?
Carchesium polypinum	Spongilla lacustris
Zoothamium arbuscula	Hydrodictyon utriculatum
Stentor polymorphus	

August 15. Higham.

Mr. Simson found some diatoms in a state of conjugation, but unfortunately was unable to name the species. It is mentioned here to induce others to look for them again next year.

Mr. Reeves gathered the beautiful Flowering Rush *Butomus umbellatus.*

August 29. Totteridge.

The ponds were quite dry.

September 12. Victoria Docks.

At this excursion, Mr. W. S. Kent had the good fortune to find a Zoophyte and one of the Nudibranchiate Mollusca, both of which, we believe, will prove to be new to the British Fauna. The following were likewise found :—

Pandalus annulicornis	Epistylis anastatica
Mysis vulgaris	Cordylophora lacustris
Diaptomus rubens	Bacillaria paradoxa
Plumatella repens	Gromia oviformis
Acineta tuberosa	Stentor polymorphus
Floscularia ornata	Actinophrys Sol
Vaginicola crystallina	Euplotus aculeatus
Cothurnia imberbis	Carchesium polypinum, &c., &c.

September 26. Hampstead.

Plumatella repens	Floscularia ornata
Limnias ceratophylli	&c., &c.

W. J. L. ARNOLD, F. W. GAY, W. W. REEVES, W. T. SUFFOLK,	Members of Excursion Committee.

Microscopical Objects in the Potash Salts of Stassfurt.

Communicated by Herr Weissflog.

If the red Carnallit of Stassfurt be dissolved in water, there remains a bulky residuum (amounting, however, only to 0·075 per cent. of the whole) which, treated chemically, is found to consist of the following ingredients, viz.:—

94·5	per cent. of	oxide of iron.
0·4	„	alumina.
1·9	„	silica.
3·2	„	matter destructible in a red heat.

Of this last 2·3 parts are soluble in alcohol.

When heated to redness this residuum emits an empyreumatic odour, and assumes a black metallic hue, which, during the process of cooling, passes again to red, and in consequence of its conversion into black oxide becomes slightly magnetic. The Carnallit from Maman, in Persia, behaves in a similar manner.

On placing this residuum under the microscope there is seen such beauty of form and gorgeousness of colouring as are scarcely to be found, even in Aventurine. Magnificent crystals develope themselves, interwoven with which are spongelike fibrous organic remains. Much has already been written about these microscopic structures, and attention has been drawn to them by descriptions and figures—A. Goebel, Mélanges physiques et chimiques de l'Acad., de S. Petersbourg, vi., 413; T. Tritsche in the same, 463; F. Bischoff, the Rock Salt Works of Stassfurt, 31; T. Cohn in Schultze's Archiv. für Microscopische Anatomie, Bonn, 1867, p. 4.—but neither description nor figure can give the same marvellous impression as is conveyed by the microscope.

First there meets the eye six-sided rhombic plates of peroxide of iron, of a yellow hue, but passing through every gradation of colouring into deep blood red. These plates gradually thin out into elongated bars, or rods, which, even under the highest powers, reach a magnitude of at most $\frac{1}{10,000}$ part of a line, and which traverse the entire texture in every direction. At one time they were supposed to be the remains of an alga *(Hygrocrocis)*, but there is no doubt of their being of the same nature as the crystals, for they remain of the same colour and shape when exposed to a

red heat, except that during the operation they assume a black hue. In addition to these forms are to be seen certain yellow crystals, of glassy clearness and of remarkable beauty; the nature of which has never yet been satisfactorily made out. Their principal constituent is likewise oxide of iron—at an earlier period they were called chrysolites—nevertheless, they have nothing in common with peroxide of iron, for both their shape and colour are changed when heated to redness. The larger crystals are precipitated when the Carnallit is held in solution; the smaller float on the surface. In the interior are to be seen peculiar markings, as though organisms were enclosed in them.

Now let that portion of the residuum which is insoluble in water be further treated with acids; it also is dissolved by repeated boiling, leaving only a small residual mass. It contains for the most part quartz crystals, remarkable for the perfection of their form and the beautiful manner in which they polarise. More rarely pyrites is discovered; at least, the smaller crystals correspond with it in colour and appearance. Still more rarely are seen lovely, colourless, highly refractive octahedra, reminding one of diamonds; but a long-continued treatment with acids proves them to be not insoluble. G. C. Kindt, of Bremen, who has done so much for the microscopic world of Stassfurt, is convinced that they are referable to boracite.

Besides these crystalline forms, a fibrous texture is met with, closely interwoven with the crystals themselves, the origin of which is undoubtedly organic. This fibrous matter is best obtained by repeated washing of the flakes, which ascend to the surface while the Carnallit is being dissolved.

I have already spoken of the delicate matted threads which were at one time assigned to the genus *Hygrocrocis*, but which appear to be identical with peroxide of iron. In this spongelike, membranous mass are scattered here and there elongated, cylindrical, partially branched filaments, of a white colour, and furnished with distinct cells—a circumstance which is infallible evidence of their organic origin.

The Rock Salt Formation of Wieliczka, referred to the Miocene period, has, as is well known, a fossil fauna of its own—mollusca, foraminifera, and ostracoda. These creatures were enabled to carry on life, because the alkaline salts were periodically washed away by fresh water, and on the whole the saline constituents of the element

in which they lived were never raised to too high a standard. But in the Salt Lake of Stassfurt, which is always filled with a far more highly concentrated solution, the existence of animal life was impossible; though, at the same time, the conditions were not unfavourable to the development of vegetable life. The definition of these vegetable forms is, however, still an open question. In G. C. Kindt's opinion, they appear to agree best with sphagnum; Karsten, of Berlin, is inclined to class them with cycads; Schimper, of Strasburg, with oscillatoræ. One thing is certain, that when the peroxide of iron is heated to redness, an empyreumatic odour is given out, on which Goebel lays great stress, as a property belonging to algæ and sponges, and which originates in the 3·2 per centage of matter, mentioned at the commencement of this paper as being destructible by fire.

NOVELTIES.

Type Slides.—At the meeting of the Quekett Club, on June 26th last, Mr. M. C. Cooke exhibited a very remarkable collection of diatoms he had just received from J. D. Möller, of Wedel, in Holstein; they were in number about 400, and were mounted on one slide, called by the preparer a "Typen-platte," and were accompanied by a key or catalogue. There was but little time to examine and appreciate this extraordinary production then, and not much information could be obtained about it in consequence, except that similar slides might be obtained for about £3 each.

Since then, Mr. Curties has placed one of these "Type-slides" in our hands for examination, and the impression produced is that our German fellow microscopists are very far advanced in manipulation. The slide is a most exquisite specimen of microscopic skill, and better still, it forms a most useful typical collection of diatomaceæ.

The slide we have examined contains 403 specimens and 387 distinct species; these are mounted in balsam in a circular glass cell, covered by a disc, the first measuring .010, and the last .006 of an English inch in thickness. It would appear from the uniformity of focus that the diatoms are placed on the inner side of the covering glass. A $\frac{1}{12}$th objective of large angular aperture can easily be used upon them. Fine specimens of *Eupodiscus Argus* are placed as marks to indicate the commencement of lines. The slide is accompanied by a written catalogue, neatly bound, in which all the specimens are entered, and numbered in their proper order. They are arranged as follows:—

Epithemieæ,	Achnantheæ,
Meridioneæ,	Cymbelleæ,
Diatomeæ,	Gomphonomeæ,
Tabellarieæ,	Naviculaceæ.
Surirelleæ,	Isthmeæ,
Nitzschiæ,	Biddulphiaceæ,
Amphipleureæ,	Eupodisceæ,
Cocconeideæ,	Milosireæ,
	Chælocereæ.

By slowly passing the slide across the field each specimen is

brought into view in succession, and can thus be named from the written catalogue.

M. Möller also prepares a test slide, containing twenty examples of diatoms, arranged in a straight line, and similarly mounted to the one described.

The idea of type slides is evidently a very good and useful one. It would be far more convenient if typical specimens could thus be mounted for reference, instead of being compelled to keep a separate slide for each.

Immersion Lenses.—The method of examining objects with the aid of a drop of fluid placed between the anterior combination of the objective, and the glass cover of the slide, has hitherto found more favour with continental microscopists than those of our own country. Foreign opticians have carried out the principle most successfully, and we have seen some excellent results produced by object glasses on this principle, costing comparatively a low price. Recently, however, Messrs. Powell and Lealand have turned their attention to the subject, and have succeeded in their efforts; we have had an opportunity of testing the arrangement with a $\frac{1}{12}$ objective, and have found the power of definition of the latter much increased. The test object was *Navicula rhomboides*,—and a very delicate specimen of it, which has always required some trouble to resolve. It was first viewed by the $\frac{1}{12}$th in question, in the ordinary way, and the two sets of markings were just made out; the new adjustment was then added, a drop of fluid placed on the front lens, and the illumination and object left untouched. When brought into focus the lines became *distinct and unmistakable dots*.

It will be observed that the original form of the object glass remains unchanged. The new system involves the addition of a front lens, which is removed when the object has to be examined in the ordinary manner.

New Pseudo-Binocular Prism.—At the October meeting, Mr. Henry Crouch, of 54, London Wall, exhibited a modification of Wenham's prism, which, by a slight alteration of adjustment, presents a pseudoscopic, or inverted image. As is well known, an ordinary Wenham prism has four surfaces, the relative position of the two reflecting surfaces determining the angle of the emergent ray. The base, as ordinarily mounted, occupies half the field; the *left* half of the cone of rays being transmitted

direct to the *right* eye, the *right* half being collected by the prism and refracted to the *left* eye.

The Pseudo-Binocular Prism has, however, five surfaces, (the emergent surface being also made twice the ordinary width). Beyond the usual base, another surface is added, ground parallel with the emergent surface, thus allowing light to pass directly through the prism at this point. As a binocular, the prism would be used in the usual manner, the ordinary base occupying the *right* half of the field, and refracting the collected rays to the *left* eye. By pushing the prism in so that it occupies the whole of the field, its action is reversed, the *left* half of the rays being refracted to the *left* eye; the *right* half passing through the parallel surfaces of prism to the *right* eye, the effect being to instantaneously invert the image, a convex surface presenting a concave appearance and *vice versa*. This ingenious modification of Mr. Wenham's prism is the invention of Mr. Ahrens; its construction does not in any way affect the performance of the instrument as an ordinary binocular, at the same time illustrating one of the most curious optical phenomena.

New Syphon Collecting Bottle, with Dipping Case.—We are indebted to Mr. George for another collecting bottle, which he has named as above, and of which we give a cut. It consists of a

Fig. 1.

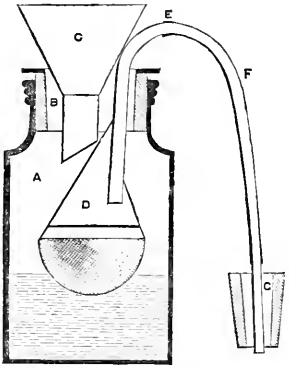
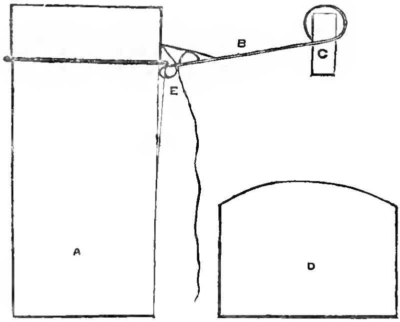


Fig. 2.



bottle, A, fig. 1, stopped by a plug, B, over which is stretched a ring of India-rubber, and into which is soldered the funnel, C, and the syphon tube, E, to which is attached the strainer, D; F is a flexible tube, with a plug attached, to be turned over to stop the mouth of

the pipe of the funnel when not in use. A, fig. 2, is a case to contain the bottle, and to be used for dipping; B is a handle playing on a joint, E, and falling close to body of case, A; C is an India-rubber ring to receive walking stick or umbrella, the point of which is thrust down to the body of the case, and fastened with twine; D is a loose cover to fit the case.

Note on Lucernaria auricula.—In order to gather a little strength, it was my good fortune a few weeks since to visit Cromer, on the coast of Norfolk. It is impossible, I think, to find a more lovely spot upon the coast—to those at least who love retirement, and who take the precaution of making their microscope a travelling companion, as I rejoice to say was my own case.

Without claiming any particular novelty, the shore afforded me on this occasion unusual enjoyment; besides various Leprarias, I found and developed the Polypes of Cellepora Cycloum, Sarcochitum, Eudendrium, &c., and if we could have extended our visit a little longer, I have no doubt we should have considerably added to the list, for the tide was beginning to wash in a larger supply; we left, however, towards the end of September.

The particular circumstance to which I beg your attention was a personal observation made upon *Lucernaria Auricula.* Johnston says it is found on the " Coast of Devonshire" and different parts of the coast, and as Cromer faces due north, I suppose it is not uncommon, although quite new to me.

We found four specimens. Three of them had been rolled by the tide, and were almost lifeless when taken, and soon died; but the fourth was taken in full vigour at low water, on the grass-like conferva frequently found upon the rocks and stones. This was on the 21st of September.

We had spent with our friends a considerable time in viewing its curious tuft of suckers, &c., but it was almost by accident rather late in the evening of the 22nd of Sept., that I felt inclined to take another look at it. The first thing which struck my attention was rather a slow motion in opposite directions in the globules or ova in one of the tubes. At first it appeared to be a circulation not very unlike the gentle motion seen in Nitella; but the size of

the globules and the structure of the zoophyte at once proved that it could not be a circulation in the usual sense of the term. Presently it changed to a very tumultuous action, and almost immediately an immense discharge of ova or globules took place from the centre of the tuft, spreading themselves like an expanding cloud of smoke. Any attempt to count them would have been quite impossible—the animal must have discharged many hundreds; they flowed forth in a continual stream for about half an hour, and then gradually subsided.

But this was not all. Towards the end of the discharge of ova, I observed a vast number of monad-looking bodies swimming about in all directions with great activity, touching the ova from time to time, and even resting on many of them which had settled on the green conferva, to which the Lucernaria was attached in the trough. I was using Powell and Lealand's 2-inch objective and binocular. On applying the two-third's objective, (the highest power which I could bring to bear upon the object, and then only when they rested on the edge of the trough,) these monad-like creatures were developed into ob-ovate bodies, evidently surrounded with cilia.

My own impression is, they were male spawn or spermatazoa, and their object the fertilization of the ova. I have never read of, or seen, that I remember, a similar occurrence, and shall be glad if your readers will correct me if I am wrong. The whole observation was more curious and interesting than I can express. I can only compare the action of these moving bodies to a swarm of bees in their hour of jubilee on occasion of the election of a new-made Queen. It was quite by accident that I was so fortunate. It did not last much more than half an hour from beginning to end; and if the spawning usually takes place after darkness has set in, as in this case, the opportunity of observing it would, of course, be very rare.

The Lucernaria in this respect seems to differ altogether from the Actinia; for when several years since I kept a Marine Aquarium, I saw the Actinia discharge their young from the mouth in a viviparous state. *Rev. J. Fry, Monson Villa, Redhill.*

QUEKETT MICROSCOPICAL CLUB.

SEPTEMBER 25th, 1868.

ARTHUR E. DURHAM, ESQ., PRESIDENT, IN THE CHAIR.

The minutes of the preceding meeting were read and approved.

The President announced that it was proposed to hold extra meetings during the months of November, December, January, February, and March, for the especial purpose of exhibiting objects, and for conversation. The evening would probably be the second Friday in the month, but final arrangements would be announced at the next meeting He also announced that Mr. Suffolk proposed to form a class for Microscopic manipulation, particulars of which might be obtained of him.

The Secretary read the following list of donations :—

"Land and Water," from the Editor ; "Science Gossip," from the publisher ; "Naturalists' Circular," from the Editor; "The Transactions of the Bristol Natural History Society," from the Society ; two slides from Mr. Curties.

The following names of gentlemen were announced as candidates for membership :—W. A. Bevington, Thomas Brabham, C. R. N. Burrows, Thomas Greenish, Henry Richard Gregory, R. H. Hughes, B.A., Jesus Coll. Camb., Samuel Knevett, William Smart.

The ballot was then taken for four gentlemen proposed as members at the last meeting. These gentlemen were subsequently declared duly elected.

The following objects were exhibited among others:—Mosquitoes from Calcutta, collected 40 years ago by Dr. Ramsbotham ; Tubuli of crab shell, by Mr. Breese; Mouth of English mosquito, shewing lancets; and Cordylophora lacustris from the Victoria Docks.

Mr. M. C. Cooke called attention to a preparation of the gill of the Sword fish, duplicates of which he had for exchange.

Mr. Slade then read a paper "On the preparation of sections of Tooth and Bone for Microscopic examination."

The thanks of the meeting were voted to Mr. Slade.

Mr. Frederick Durham asked if any one had any experience in the method of preparing teeth by first breaking them in small pieces and then soaking them in glycerine, recommended by Dr. Beale.

Mr. Suffolk observed that Dr. Beale recommended acidulated glycerine, which had the effect of dissolving the calcareous portion, leaving the animal matter only. Dr. Carpenter had remarked that glycerine dissolved carbonate of lime, some of his preparations having been spoiled in consequence of this action upon them. He could confirm this as some of his own objects had been injured by the glycerine in which they were mounted.

The President made some remarks of which Mr. Slade has furnished a note at page 119.

It having been announced that at the next meeting a paper would be read by Mr. Tatem "On Melicerta Ringens," the meeting concluded with a conversazione.

OCTOBER 23RD, 1868.

ARTHUR E. DURHAM, ESQ., PRESIDENT, IN THE CHAIR.

In the absence of the Honorary Secretary, Mr. M. C. Cooke read the minutes of the preceding meeting, which were approved.

The following donations were announced :—

"Science Gossip," and the "Popular Science Review," from the publisher; "The Transactions of the Bristol Natural History Society," from the Society; a paper on "Diatomaceæ," from Dr. Edwards; "The Naturalists' Circular," from the publisher; one slide from Mr. Groves; six slides of mosquitoes from Mr. Edwards; twelve slides from Mr. Thomas Russell; and one hundred slides from Mr. M. C. Cooke.

The thanks of the meeting were returned to the respective donors.

The following gentlemen were proposed for membership :—William Adkins, James Boustead, W. Delferier, F.R.M.S., Rev. R. C. Douglas, Thomas Parker, Benjamin Pritchett.

The names of eight gentlemen proposed at the last meeting were then balloted for and subsequently declared duly elected.

Among the objects exhibited were,—Cypris monarcha and other Entomostraca, by Mr. Curties; Foot of hornet as a polariscope object, by Mr. J. W. Groves; Circulation in the heart of a water flea, by Mr. Martinelli; living specimens of Foramenifera and Marine Polyzoa from Dover, by Mr. Hainworth; living Desmids and Diatoms from Kilburn, by Mr. Bockett; and Mysis vulgaris, by Mr. Gay.

The President gave notice that at the next meeting it would be proposed that any members desirous of compounding for their future annual payments might do so on payment of £10, all such compounding fees to be invested at the discretion of the Committee, so as to form a permanent fund.

Mr. S. J. M'Intire then read a paper on Cheyleti.

The thanks of the meeting were voted to Mr. M'Intire.

Mr. George exhibited and described a new syphon collecting bottle. See page 143.

Mr. T. C. White read the following note on a new cement for Microscopical purposes :—

"Among the many genial characteristics of the Quekett Microscopical Club none stand more prominent than the warm and ready reception given to any suggestion thrown out by its individual members for the common benefit of the work of the Society; it is with this conviction that I am induced to call your attention to an agent hitherto little employed in the mounting of objects for the Microscope.

"It is a very desirable thing to have an agent by which an object may be quickly put up and placed away out of danger of dust and damage. This I find in the solution of Gum Dammar in Benzole, a few bottles of which I have placed on the table for distribution. The gum can be procured at a very cheap rate at most varnish makers and it dissolves readily in Benzole. The solution forms a very sticky cement and can be used wherever gold size is usually employed, but with the advantage that it dries instantaneously. I find it very useful in mounting thin objects in fluid, and the plan I adopt is as follows :—I run a ring of the Gum Dammar cement on my slide with the turn table, then put the preservative fluid in the ring with the object in, press down the covering glass, thus squeezing out the superfluous fluid, the glass sticks firmly in spite of the moisture, no air-bubbles run in, and after drying it off with blotting paper I run a second ring round and put it away. Such slides I have had for upwards of two

years and they show no change in the cells, no milkiness, no air-bubbles, and the cement remains firm. Feeling convinced that its use is attended with so many great advantages I thought I should be acting the part of a churl if I kept back its knowledge from the Society any longer."

The communication was accompanied by some bottles of the cement for distribution.

The thanks of the meeting were voted to Mr. White.

Referring to his large donation of slides to the cabinet of the Club, Mr. Cooke remarked that their value chiefly consisted in their being carefully named, and therefore constituting an authority to which members might refer for the identification of specimens. Mr. Cooke also intimated his willingness to deliver a course of lectures on Microscopic Fungi if not less than 15 gentlemen would send in their names as desirous of forming a class for the purpose.

Mr. W. T. Suffolk also stated his intention to re-commence his classes for instruction in Microscopical Manipulation Gentlemen desirous of attending were requested to give early notice of their intention to Mr. Johnson; not more than 15 members were required, and those who had attended the previous courses were requested to volunteer as assistants. Members were also requested to bring with them their own microscopes, which should not be inferior to Messrs. Smith and Beck's five-guinea instrument.

The President having reminded members of their subscriptions, announced that a paper "On Melicerta Ringens," by Mr. Tatem, would be read at the next meeting, and that a paper "On British Graptolites" had been promised by Mr. John Hopkinson.

The meeting terminated with the usual conversazione.

NOVEMBER 27TH, 1868.

ARTHUR E. DURHAM, ESQ., PRESIDENT, IN THE CHAIR.

The minutes of the preceding meeting were read and approved.

In accordance with the notice given at the preceding meeting, the President declared the meeting a special one for considering the following addition to the Bye Laws,—"That any member desirous of compounding for his future subscriptions may do so at any time by payment of the sum of £10; all such sums to be duly invested in such manner as the committee shall think fit."

The resolution that the above should form part of the Bye Laws being put from the chair, was carried.

The following donations were announced:—

"Transactions of the Bristol Natural History Society," from the Society; "Science Gossip," from the Publisher; the "Naturalists' Circular;" from the Editor; "Land and Water," from the Editor; Six slides of American musquitoes and their eggs, from Dr. Purley, of Portland, Maine, U.S.A.; 160 slides from Mr. Cooke; one slide of Halodactylus and one of Sertularia, from Mr C. Collins; four slides of varieties of Crystals of Santonine, from Mr. Hislop; one slide of Aventurine, from Mr. G. E. Quick; and four slides of selected Pleurosigmæ, from Dr. Dempsey.

The thanks of the members were voted to the donors.

The following gentlemen were proposed for membership:—John Ashby, W. E. Coe, Samuel Eyre, Robert J. Farmer, James B. Jordan, Henry Lloyd, Benjamin Thompson Lowne, M.R.C.S., Richard Mestayer, F.R.M.S., George Mundil, M.R.C.S., Thomas Nicholson, Ph. D., F.G.S., C. A. Redl, William Scantlebury, D. Sowerby, James Swift, Arthur Waller, F.R.M.S., Alfred Warner.

The six gentlemen proposed at the previous meeting were then ballotted for, and declared duly elected.

The Secretary informed the members that a Microscopical Society on a similar basis to their own was being formed at Liverpool. He read the circular announcing the plan of the proposed Society, which he had received from a gentleman who had previously asked for information as to the working of the Club. He had subsequently heard that a preliminary meeting had been held, at which 58 members were enrolled.

The following objects for exhibition were announced:—Falces of Garden Spider, by Mr. Martinelli; Antennæ of Japanese Silkworm, by Mr. Golding; Tongue of a Fly, mounted in fluid, by Mr. Hainworth; Selected Diatoms, by Dr. Dempsey and Mr. Hislop.

Mr. Curties then read a paper by Mr. Tatem, "On a new Melicertian and on Melicerta Ringens." The paper was illustrated by coloured drawings. See page 124.

The thanks of the members were voted to Messrs. Tatem and Curties.

After the reading of Mr. Tatem's paper, Mr. Henry Davis alluded to Mr. Tatem's reference to a paper read by him some two years ago before the Royal Microscopical Society, which he had unintentionally misquoted in that portion relating to *Œcistes longicornis*. A glance at the copy of the paper on the table would show that no such resemblance to Limnias was noted by him. Mr. Tatem's error might be accounted for by the fact that before describing *Œ. longicornis*, he had given a short account of *another* rotifer, and noted the resemblance of that—and that only—to Limnias. The new rotifer (*Limnioides myriophilli*) just described, he had very often seen, and considered a variety of *Limnias ceratophylli*; it might perhaps be well to register it as a new species, but there appeared no warrant for establishing a new genus for its reception. It resembled *Limnias ceratophylli* in every important particular; had the same bilobed rotary organs, same sheath and same gizzard; the only difference was in the mounting of the tactile setæ, these in Limnias being on two tubercles—one on each side of the neck; while in the new rotifer they were placed at the free ends of short processes, exactly like the antennæ in Melicerta. He was assuming that the creatures he had seen were the same as those Mr. Tatem described and figured.

(In reference to the above remarks, Mr. Tatem writes as follows:—"Mr. Davis is certainly in error in supposing that I make any confusion between his two species *Œcistes longicornis* and *Œ. intermedius*. To the latter I do not refer at all. Taking it to be merely a variety of Limnias, it was not necessary to my purpose, that of suggesting the establishment of a new genus for the artificial arrangement of Tubicolæ with two syphons and two lobes, and expressing an opinion, well or ill-founded as it may be, of a community of origin amongst them as illustrated by varieties of Melicerta.")

Mr. Lowne read a paper on "The Proboscis of the Blow Fly," illustrated by coloured drawings. See page 126.

A cordial vote of thanks was awarded to Mr. Lowne for his paper.

Mr. Suffolk congratulated Mr. Lowne upon his having cleared up the uncertainty which had enveloped this subject for the last 80 years. With one or two exceptions, the writers during that period appeared to have followed descriptions of distorted mounted specimens. He had himself been working at the subject for a long time, but Mr. Lowne appeared to have had more advantages, and he congratulated him on his success. At an early meeting of this Society he had conferred with the late Mr. Richard Beck, and showed him a drawing

made in 1853. He had lately applied to Mr. Beck's representatives to know if he had left anything relating to the matter amongst his papers, and was informed that there was nothing but a very beautiful drawing, dated 1862. Since Gleichen's work on the House Fly, no one seemed to have paid any real attention to the subject.

The President mentioned that in 1862 Mr. Beck shewed him for the first time the proboscis of a fly as it ought to be seen, namely, in the living state. It was placed in a live box, with a little glycerine or honey on the inside of the cover, and the working of the labia was well displayed.

The President announced that the Committee had arranged for extra meetings to be held during the winter months for the purposes of manipulation and conversation. The Council of University College had very handsomely placed at their disposal a room on the second Friday evenings in December, January, February, and March. The hours of meeting to be from 7 to 10.

It was proposed to form a committee of six gentlemen to carry out the plan. Three had been nominated by the Council—namely, Messrs Gay, Hailes, and Hislop, and the remaining three were to be then appointed from among the members.

Messrs. Dobson, Ambrose Smith, and White having been nominated, were duly elected to serve on the sub-committee for managing the extra meetings.

Mr. Burgess called attention to a new collecting case arranged by Mr. Stanley, of Great Turnstile.

The President announced that the next meeting would be held on December 18th, as the fourth Friday fell on Christmas day.

A paper was announced by Mr. Hopkinson "On British Graptolites," and one by Mr. Samuel Holmes "On a new form of Binocular."

The meeting terminated in the usual manner.

EXTRA MEETINGS.

The first of the series of extra meetings for conversation and the exhibition of objects, was held on Friday, the 11th December, in the Library of University College (the use of which has been courteously granted by the Council).

The Committee appointed to superintend these meetings—Messrs. Hislop, Hailes, Gay, A. Smith, T. C. White, and Dobson—were in attendance at half-past six o'clock, and made suitable arrangements for the accommodation of members bringing their instruments.

The following gentlemen exhibited microscopes :—

Mr. Suffolk; Discs in splinter of lucifer match, with 4-10ths, and parabolic reflector.

Mr. Oxley; Melicerta, Stephanoceros, &c.

Mr. McLeod; a numerous collection of mosses and whole insects.

Mr. White; a method of crystallizing under the microscope.

Mr. Hailes; a series of Foraminifera from the Phillipines, drawings, &c.

Mr. Golding; various spiculæ.

Mr. Wright; curious web attachments formed by spiders.

Mr. Hislop; crystals of Santonine. Lips of the fly mounted in their natural state.

Mr. Gray; Floscularia. Mr. Curties, Polycistina. Mr. Grove; Diatomaceæ.

Mr. Collins; Zoophytes. Dr. Matthews; ferns.

Eighteen microscopes were on the tables, and these, with the books and objects belonging to the Club, enabled the members (of whom 60 were present), to spend a pleasant evening, and much practical information was elicited.

THE JOURNAL

OF THE

Quekett Microscopical Club.

On British Graptolites. By John Hopkinson, F.R.M.S.

(Read December 18th, 1868.)

In one of the oldest series of rocks, the Silurian, a peculiar group of fossil zoophytes, called Graptolites, occurs. They are exclusively confined to the Silurian formation, and in its lower division are frequently unaccompanied by any other fossils. They are by far the most abundant in the Skiddaw slates and Llandeilo flags, lessening in number, both of species and individuals, in the Upper Silurian rocks, until, in the Ludlow, but two species are found. Their geological range is thus comparatively very limited; but their geographical range is world-wide. In Britain, on the Continent, in America, and in Australia; in fact, wherever Silurian rocks occur, graptolites abound.

To what class of zoophytes they belong, whether to the Hydrozoa, the Actinozoa, or the Polyzoa (Bryozoa), is not easily determined. Sir Roderick Murchison says, "They are supposed by many naturalists to have been zoophytes nearly allied to the living Virgularia, a creature known only in deep water. Others rather consider these extinct forms to belong to Sertularian zoophytes, or even to Polyzoa. Be this as it may, the geologist has observed that they are found *exclusively* in the Silurian system of life."

As microscopists, however, we need not enter further into the geological or geographical range of graptolites, but consider instead, their structure, history, classification, and affinities.

§ I. Structure.

Assuming for the present that the Graptolitidæ form a distinct order of the class Hydrozoa, it seems necessary to explain the terms proposed for this class by Dr. Allman and Professor Huxley, as, though now generally adopted, they are by no means widely known.

The body of every Hydrozoon consists of a sac composed of two membranes, an outer, called the *ectoderm*, and an inner, the *endoderm*. This entire double-walled body is termed a *hydrosome*, and consists in its simplest form, as seen in the fresh water *Hydra*, of a disc of attachment, the *hydrorhiza*; a sac for the digestion of food, the polypite; and processes for seizing food, the tentacles. At certain seasons reproductive organs are developed.

In the majority of the Hydrozoa there are several polypites organically united by a common connecting fleshy basis, termed the *cœnosarc*, forming, in the Corynidæ and Sertulariadæ, the nearest allies of the Graptolitidæ, a branching stem, a transverse section of which is usually nearly circular.

The growth of every hydrosome takes place from one end, which does not further develope. This end may be in any position, upwards, downwards, or sideways. It is termed the *proximal* end; the other, or growing extremity, being termed the *distal* end. The proximal end forms a hydrorhiza, either expanding into a disc, or sending out *radicles*, by which it attaches itself to other bodies.

That portion of the hydrosome which intervenes between the hydrorhiza and the first polypite is termed the *hydrocaulus*. The opposite ends of the individual polypites are also termed proximal and distal; the proximal being attached to the supporting cœnosarc, and the distal being armed with filiform tentacles.

The individual polypites of many Hydrozoa are protected by cup-like receptacles, commonly called polype cells, entirely composed of the cuticular layer of the ectoderm. These are termed *hydrothecæ*.* The cœnosarc also has a protecting covering, termed the *periderm*; the whole covering of the soft parts being called the *polypary*. The tentacles are never protected by a special covering.

* It may be objected that the word cell or cellule is applicable, and is more convenient than hydrotheca; but to a microscopist a cell is the ultimate particle of living tissue, and a cellule is but a little cell.

The word mouth has likewise been used for the aperture or orifice of each hydrotheca; but the opening through which the polypite protudes its tentacles, as well as the distal extremity of its body, cannot certainly be called a mouth!

Of graptolites nothing is preserved besides the polypary—the cænosarc, polypites, and tentacles having perished.

The reproductive organs of the Hydrozoa consist usually of portions of the ectoderm developed into pouches or sacs, termed *gonophores*. These are always external, generally budding from the cænosarc, to which, or to the protecting periderm, they are at first attached. In the Sertulariadæ these gonophores, or generative buds, are sometimes developed directly from the cænosarc, and sometimes from the *gonoblastidium*, a peduncle, which rises from cænosarc and has a similar structure. The gonophores are sometimes contained in cup-like receptacles, termed *gonothecæ*. The entire reproductive organs, whatever be their nature or form, are included under the general term *gonosome*.

These are but a few of the terms specially relating to the Hydrozoa, yet they are more than sufficient for the graptolite. There is, however, one structure peculiar to the Graptolitidæ, and that is, a slender solid axis, supporting the hydrosome in every direction.

We shall now easily understand the structure of the graptolite.* The proximal end, or initial point, which appears seldom to have been attached to foreign bodies, consists of a radicle, and is sometimes invested with a corneous disc. The radicle is sometimes long and slender, sometimes broad and tapering, and sometimes only a minute point. It seems to be merely the proximal termination of the solid axis. In many graptolites a short spine is developed on each side of the radicle, and sometimes, though very rarely, the radicle itself bifurcates. The corneous disc is only present in some of the branching forms, uniting the proximal terminations of each branch. It consists of two membranes, and may have contained a substance of the same fleshy nature as the cænosarc. Its purpose seems to have been to give strength and rigidity to the polypary.

Between the radicle and the first developed hydrothecæ, in many branching forms, a non-polypiferous portion of the periderm intervenes. Hall has called it the *funicle*, but as it is analogous to the hydrocaulus of recent Hydrozoa, no new term is needed. This hydrocaulus differs from the rest of the periderm, only in being composed of a thicker membrane, and containing a smaller central canal.

* All the points of structure and varieties of form here referred to are illustrated in Plate VIII.

From the radicle proceeds the solid axis. With reference to the cænosarc and polypites it is dorsal in position,* being placed in a hollow at the back of the cænosarc, and outside the protecting periderm, from which it is easily separable. In form it is usually solid and cylindrical; sometimes it is composed of two thin laminæ; and in one genus it is cruciform. It gave strength and support to the whole polypary. It is frequently prolonged beyond it, and has a similar horny structure.

Attached to the solid axis is the periderm, containing the cylindrical common canal. The cænosarc which it enclosed has perished.

On the margin of the periderm the hydrothecæ are developed. Between them, and the common canal, there is no constriction or septum, showing that the individual polypites were immediately developed from the cænosarc, the whole being organically united; each individual polypite contributing, through the cænosarc, to the nourishment of the whole colony.

The entire polypary consists of a flexible horny or chitinous cuticle, usually, in the process of mineralisation, carbonized, or metamorphosed into iron pyrites.

The hydrothecæ are more or less in contact throughout their length, or are entirely separated. When in contact, they usually form an acute angle with the axis; when separated, they are often rectangular to it. In some peculiar forms there are no distinct hydrothecæ, their orifices being excavated in the margin of the polypary, which is continuous throughout. The hydrothecæ, in these forms, are in contact for their whole length, and have but a single wall of division between them; while, in the ordinary forms, each is perfect in itself.

The hydrothecæ may be developed in one or more series from the axis. When in one series, the axis is round; when in two, they are disposed on each side of a double axis, which is sometimes flattened; when in four, they are arranged in a cruciform manner round a cruciform axis. Their form and position are very varied; but we can, I think, collect the various forms into five types—*linear*, *curvilinear*, *tubular*, *rectangular*, and *incised*.

Under the term linear I include those long, narrow hydrothecæ, which are entirely separated from each other (*Pl.* viii., *f.* 1). The term curvilinear is intended to take in those bounded by curved

* In graptolites with a double series of hydrothecæ it is dorsal to each series.

lines, which gradually approximate towards the aperture (*Pl.* viii., *f.* 2, 4, 5, *and* 12). The curvilinear hydrothecæ are united only at their base; while the tubular have their superior or distal margin entirely in contact with the lower portion of the inferior or proximal margin of the next hydrotheca (*Pl.* viii., *f.* 3, 6, 7, 9 (?), 10, 11, 13, *and* 14). The rectangular differ only in being angular in section, instead of round (*Pl.* viii., *f.* 8, 18, *and* 20). Sometimes they are in contact for their whole length (*Pl.* viii., *f.* 18 *and* 20). In the incised forms the inferior wall of each hydrotheca forms the superior wall of the next (*Pl.* viii., *f.* 15. 16, 17, *and* 19). I have already alluded to them as having no distinct hydrothecæ.

The inferior margin of the aperture of the tubular hydrothecæ is sometimes ornamented with a mucronate extension, or spine (*Pl.* viii., *f.* 3*b*). In the incised, the superior margin of the aperture is sometimes extended into a mucronate point (*Pl.* viii., *f.* 19). In some species there is a row of minute pustules near the base of the hydrothecæ (*Pl.* viii., *f.* 17*b*). In many fine striæ, parallel to the margin of the apertures, are apparent (*Pl.* viii., *f.* 13*b*); they appear to be lines of growth. The periderm of some genera is ir regularly striated; in others, it has a granular appearance. In one or two species, I have detected, where the cuticular layer, or ectoderm, appears to have been removed—a reticulated appearance. But from the imperfect state in which graptolites are preserved, the nature or *utility* of these surface markings is doubtful. Careful study of well preserved specimens under the microscope,* and especial care in the illumination, may clear up these and other doubtful points of structure.

§ II. History.

I can only touch briefly on the history of the British graptolites.

Bromel most probably alluded to graptolites, when, in describing the fossils of Sweden, in 1727, he speaks of the fossil leaves of grasses.

Linnæus, in the first edition of his "Systema Naturæ" (1736), applies the name *Graptolithus* to certain natural objects, fucoid markings, worm tracks, &c. In his "Scanian Travels" (1751), he first describes and illustrates under this generic name, a true grap-

* A three or four-inch object glass should be used. A four-inch, made for me by Mr. Collins, shows structure much better than a higher power.

tolite, which he names *G. scalaris*. The figure represents a graptolite with incised hydrothecæ, their apertures being on its upper surface, and from this such specimens have been called "scalariform impressions." This species does not appear in the "Systema Naturæ" until the twelfth edition (1767), the last edited by Linnæus himself It was the only true graptolite known to him, and he did not consider it a real fossil, but only a mineral aggregation, or "lusus naturæ."

In 1821, Wahlenberg considered that the graptolites of Sweden were orthoceratites.

In 1828, Brongniart, in his "Histoire des Végétaux Fossiles," referred them to the Algæ, describing two species as *Fucoides dentatus* and *F. serra*.

Nilsson, soon after, referred to them as ceratophydian polypes, and proposed for the true graptolites the name *Priodon*, a name previously given by Cuvier to a genus of fish.

Bronn, in 1835, fell into the same error as Nilsson, by substituting the name *Lomatoceras*, previously given to a genus of insects.

Hisinger, in 1837, described five species from Sweden, under the generic name *Prionotus*.

Murchison, in the first edition of his "Silurian System" (1839), altered the original name *Graptolithus* to *Graptolites*, describing three species; and Beck added in a note, that he considered graptolites nearly allied to *Pennatula* or *Virgularia*.

Geinitz, in 1842, described five species, considering them Cephalopoda.

Portlock, in the following year, first suggested their true affinities. In his "Geological Report on Londonderry," he recognised them as true zoophytes, allied to *Sertularia* and *Plumularia*, and suggested that they should be formed "into several genera, belonging even to more than one order."

Barrande, in a memoir on the graptolites of Bohemia (1850), first subdivided the genus. He established the genera—*Rastrites* for species having the hydrothecæ separated by a considerable interval; and *Retiolites*, for species which are not true graptolites, having no solid axis, and a polypary of entirely different structure. He also divided the remaining species of the genus *Graptolithus* into two sections—*Monoprion* and *Diprion*; the former having a single series of hydrothecæ; the latter, a double series. The name *Diprion* had previously been applied to a genus of insects.

McCoy, in the same year, raised these sections into genera, altering the name *Diprion* to *Diplograpsus*, and retaining the original name *Graptolithus* for the section *Monoprion*. In the following year he established the genus *Didymograpsus* for species having two simple branches.

Hall, in 1857, described a remarkable form with four series of hydrothecæ, naming it *Phyllograptus*. In 1865, he proposed three new genera—*Dendrograptus*, for species branching and re-branching from a thick hydrocaulus; *Climacograptus*, for species having a double series of hydrothecæ excavated in the margin of the polypary; and *Dicranograptus*, for species having a single and double series of hydrothecæ on the same polypary.

In 1858, Carruthers proposed the name *Cladograpsus*, for species growing irregularly in two directions from the radicle, and repeatedly branching; and in 1867, *Cyrtograpsus*, for species repeatedly branching in one direction from the radicle.

In 1861, Salter proposed the name *Dichograpsus*, for species having many branches growing bilaterally from a central disc; and in 1863, *Tetragrapsus*, for species having only four branches.

Nicholson has recently (1867) added the synonym *Pleurograpsus* to the genus *Cladograpsus*, Carr.

§ III. Classification.

In a series of papers in Sir R. Murchison's "Siluria" (ed. 1867); in the "Intellectual Observer" (May and June, 1867); and in the "Geological Magazine" (February and March, 1868), my friend, Mr. William Carruthers, groups all British genera of graptolites into four sections. The genera of Section I. have a single series of hydrothecæ; of Section II., a double series; of Section III., a single and double series; and of Section IV., a quadruple series. In a paper read before the Geologists' Association last April, I proposed to consider these sections sub-orders, or rather families, and named them respectively—*Monoprionidæ*, *Diprionidæ*, *Monodiprionidæ*, and *Tetraprionidæ*. The family *Monoprionidæ* corresponds to Barrande's section *Monoprion* (including *Rastrites*), and the family *Diprionidæ* to his section *Diprion*.

The following is an arrangement of the British genera. It differs but little from that of Mr. Carruthers.

Sub-Kingdom, CŒLENTERATA. Class, HYDROZOA.
Order, GRAPTOLITIDÆ.

Family I. MONOPRIONIDÆ. Polypary with a single series of hydrothecæ.

Genus 1. RASTRITES, Barrande (Grapt. de Bohème, p. 64).

Polypary simple (unbranched), consisting of a slender tubular periderm supporting linear hydrothecæ, free throughout their whole length. *R. peregrinus* Barr. (*Pl.* viii., *f.* 1) is the typical species.

Genus 2. GRAPTOLITHUS, Linnæus (Systema Naturæ, Ed. 1).

Polypary simple, consisting of a tubular periderm supporting hydrothecæ in contact for more or less of their length. *G. priodon*, Bronn (*Pl.* viii., *f.* 2), and *G. Hisingeri*, Carr (*Pl.* viii., *f.* 3), are widely distributed species. I also figure one of the many varieties of *G. Sedgwickii*, Portl. (*Pl.* viii., *f.* 4). It bears some resemblance to *G. Salteri*, Gein., to which I at first referred it.

Genus 3. CYRTOGRAPSUS, Carruthers (Murch. Sil., Ed. iv., p. 540).

Polypary compound, growing in one direction from the proximal end, and consisting of a periderm giving off branches from the side on which the hydrothecæ are developed. The branches re-branching in a similar manner. *C. Murchisoni*, Carr., is the only species of this genus (*Pl.* viii., *f.* 5).

Genus 4. DIDYMOGRAPSUS, McCoy (Brit. Pal. Fossils, p. 9).

Polypary consisting of two simple branches, growing bilaterally from the radicle, and bearing hydrothecæ on the margin opposite the radicle. "The branches of the polypary sometimes extend at right angles to the initial process, sometimes they are bent backwards upon it, and less frequently they are turned inwards from it." (Carruthers.) *D. Murchisoni*, McCoy, is a characteristic species (*Pl.* viii., *f.* 6).

Genus 5. TETRAGRAPSUS, Salter (Journ. Geol. Soc., vol. xix., p. 135).

Polypary consisting of four simple branches, growing bilaterally from a short hydrocaulus which is sometimes invested with a corneous disc. *T. bryonoides*, Hall (*Pl.* viii., *f.* 7).

Genus 6. DICHOGRAPSUS, Salter (Geologist, vol. iv., p. 74).

Polypary growing bilaterally and branching regularly, the hydrocaulus or non-polypiferous base of the branches invested with a corneous disc. *D. octobrachiatus*, Hall (*Pl.* viii., *f.* 8).

Genus 7. CLADOGRAPSUS, Carruthers (Trans. R. Phys. Soc., Edin., 1858, p. 467).

Polypary growing bilaterally from the radicle, and consisting of two primary branches, each of which branches and re-branches from the same side of the periderm on which the hydrothecæ are developed, the radicle being on the opposite side. *C. linearis*, Carr. (*Pl.* viii., *f.* 9).

Genus 8. DENDROGRAPTUS, Hall (Grapt. Quebec Group, p. 126).

Polypary repeatedly branching, in a dichotomous manner, from a thick hydrocaulus composed of the united non-polypiferous bases of the branches, the hydrorhiza probably consisting of a disc of attachment. *D. Hallianus*, Prout (*Pl.* viii., *f.* 10).

This genus forms a connecting link between the true graptolites and the genera *Callograptus*, *Dictyonema*, and *Oldhamia*.

Family II. DIPRIONIDÆ. Polypary with a double series of hydrothecæ.

Genus 1. DIPLOGRAPSUS, McCoy (Brit. Palæozoic Foss., p. 7).

Polypary simple, with hydrothecæ developed alternately from each side the periderm; each series of hydrothecæ having a separate common canal. The solid axis is frequently prolonged distally beyond the polypiferous portion of the periderm, and terminates at the proximal end in a radicle, sometimes furnished on each side with a short spine. In a peculiar form I found in the Frenchland Burn, Moffat, the prolonged axis is enveloped in a non-polypiferous portion of the periderm. This is a new species, for which I propose the name *D. penna*.

Description—*D. penna*, sp. nov. (*Pl.* viii., *f.* 12). Hydrothecæ slightly curved, concave on the distal margin, which is at right angles to the axis, and convex on the proximal, which makes an angle, with the axis, of about 45 degrees. There are 20 hydrothecæ in the space of an inch, united only at their base. The breadth across the entire polypary is 1-8th of an inch.

D. folium, His. (*Pl.* viii., *f.* 13), is a very peculiar form. *D. pristis*, His. (*Pl.* viii., *f.* 11), is the most common species of the genus.

I do not include in this genus the species *D. cometa*, Gein. Mr. Carruthers suggests that it should be made the type of a new genus, for which I here propose the name *Cephalograpsus*.

Genus 2. CEPHALOGRAPSUS, gen. nov.

Hydrothecæ opposite, tubular, few in number, formed into a head at the distal end of the polypary, and collected into a common canal at the proximal end. *C. cometa*, Gein. sp. (*Pl.* viii., *f.* 14).

Genus 2. Climacograptus, Hall (Grapt. Quebec Gr., p. 111).

Polypary simple, with incised hydrothecæ excavated alternately in each side of the polypary; the common canal communicating between the two series of hydrothecæ. The solid axis is frequently prolonged distally, and the radicle is sometimes very long and slender. *C. scalaris*, Linn. (*Pl.* viii., *f.* 15). *C. bicornis*, Hall (*Pl.* viii., *f.* 16).

The genus *Retiolites*, a diprionidian form, I do not consider a true graptolite.

Family III. Monodiprionidæ. Polypary with a single and double series of hydrothecæ.

Genus 1. Dicranograptus, Hall (Grapt. Quebec Gr., p. 57).

Polypary, towards the proximal end with a double series of hydrothecæ, dividing distally into two branches bearing hydrothecæ on their exterior margin only. The solid axis is double, bifurcating in the axil of the branches. In *D. ramosus*, Hall (*Pl.* viii., *f.* 17), the hydrothecæ appear to have the same structure as in *Climacograptus*.

Family IV. Tetraprionidæ. Polypary with a quadruple series of hydrothecæ.

Genus 1. Phyllograptus, Hall (Canada Geol. Surv. Report, 1857, p. 135).

Polypary with four series of hydrothecæ arranged in a cruciform manner round a cruciform common axis. Each series of hydrothecæ has its own common canal, not communicating at all with the other series, and in each series the hydrothecæ are in contact for their whole length. *P. angustifolius*, Hall (*Pl.* viii., *f.* 18).

§ IV. Zoological Position.

Naturalists seem to have almost the same diversity of opinion as to the zoological position of graptolites, now, as they had years ago. Professors McCoy and Wyville Thompson place graptolites among the Sertularian Hydrozoa; M. Milne Edwards considers they "have more affinity with *Virgularia*," an Actinozoon, "than with any other recent zoophyte;" Professor Huxley and Mr. Salter refer them to the Polyzoa; while Professor Owen and Mr. Carruthers class them among the Hydrozoa.

That they are really zoophytes there cannot be the slightest

doubt. Let us compare them with the three classes into which zoophytes are divided—the Cœlenterate Hydrozoa and Actinozoa, and the Molluscan Polyzoa.

The Actinozoa are divided into two sub-classes—Alcyonaria and Zoantharia. The Zoantharia have not the slightest resemblance to the graptolite.

The Alcyonaria have a certain superficial resemblance; the chief point relied upon by those who refer graptolites to this sub-class being the presence of a solid axis in certain genera—*Pennatula*, *Virgularia*, *&c.*; but this axis is "thick and calcareous, and proceeds from the proximal end," while in the graptolite it is "slender and corneous, and is produced at the distal end." The polypites, moreover, are contained in the fleshy body of the Alcyonarian zoophytes, while in graptolites they were contained in specially developed thecæ.

Graptolites, therefore, have a totally different structure to the Actinozoa. Let us try the Polyzoa.

Most of the Polyzoa are protected by a calcareous polypary. In graptolites it is chitinous. In most of them, also, each polypite is entirely cut off from all the others by a septum. In one order only—Ctenostomata, is there a chitinous polypary, and it is singular that in this order the septum is not entire; there is a small perforation by means of which the polypites are organically united to a common canal. In graptolites, however, there is not the slightest constriction, or indication of a dividing septum, if we except a few forms in which there is an impressed line between the hydrothecæ and the periderm. This appears to be merely a surface mark, similar to that at the base of the hydrothecæ in the Sertulariadæ.

Graptolites, therefore, having no septum, either entire or perforated, cannot be Polyzoa. We are now reduced to the humbler Hydrozoa.

The polypary of many of the Hydrozoa is of the same nature as that of the graptolite, and the internal structure is similar, as we have already seen. There are free and fixed forms in the Hydrozoa, and most probably, also, in the Graptolitidæ. It is true that in only one genus of graptolites, *Dendrograptus*, have we an indication of a hydrorhiza capable of attachment, while all the most nearly allied Hydrozoa are fixed.

The organic connection, without any septum, between the individual polypites and the common cœnosarc, which is universal in

both graptolites and recent Hydrozoa, warrants us, I think, in including them in this class, and it only remains for us to decide their ordinal position.

Professor Huxley divides the Hydrozoa into six orders, or, including the provisional order, Medusidæ, seven. Of these, we may dismiss from our consideration all but two—the Corynidæ and the Sertulariadæ—they only having a cuticular ectoderm. In the Corynidæ the hydrosome is developed into a cænosarc, supporting many polypites without thecæ; in graptolites, the polypites were contained in true thecæ; the genus *Climacograptus* is apparently an exception. In the Sertulariadæ, the ectoderm of the cænosarc supports polypites enveloped in thecæ. This is the structure of the graptolite.

But in neither the Corynidæ nor the Sertulariadæ, nor, in fact, in any Hydrozoon, is there a solid axis. Were it not for this, we might place graptolites in the order Sertulariadæ; but as it is, we must consider them a distinct order, their precise zoological position being between the Corynidæ and the Sertularidæ, and their nearest alliance being with the latter order.

I should not omit to mention that I am indebted to Mr. Carruthers for most of the arguments I have used. In his paper in the "Geological Magazine" for the present year (1868), to which I refer you for further information, this question is treated much more fully than I have here attempted.

§ V. Reproduction and Development.

Of the mode of reproduction of graptolites little certain is known. In the graptolitic shales of Dumfriesshire there occur certain oval bodies bearing some resemblance to the gonothecæ of Sertularians. They have been figured in the "Geological Magazine" for 1867, by Dr. Nicholson, as actually growing out of specimens of *Graptolithus Sedgwickii;* but it is supposed that such appearances are merely due to cases of accidental juxtaposition. In the autumn of 1866, when I first became acquainted with graptolites, I found these organisms in abundance, in the precise locality from which Dr. Nicholson obtained his specimens—Garple Linn, Moffat; but I could never trace their connection with any graptolite.

In the "Graptolites of the Quebec Group" (of Canada), Hall figures a *Diplograpsus* with reproductive sacs attached to its periderm. Adjoining the margin of one of these sacs are two

young graptolites *(Pl.* viii., *f.* 30*)*. The recent *Tubularia*, a Hydrozoon, is propagated in a somewhat similar manner, "the capsules giving birth to progeny closely resembling the parent." (Carruthers).

Of the development of graptolites we have more certain knowledge. I have found young graptolites in all stages of growth, from a mere microscopical point to a completely formed polypary *(Pl.* viii., *f.* 22—25*)*. I have never found them in connection with the supposed gonophores, or gonothecæ. In fact, where young graptolites are most abundant, these organisms are rare; and in the only locality near Moffat where Dr. Nicholson's *grapto-gonophores* are numerous, I do not remember seeing a single germ. Germs or young graptolites are figured in the "Geological Magazine" and in the "Intellectual Observer" for 1867; in the former, by Dr. Nicholson; in the latter, by Mr. Carruthers. They are also figured in Hall's "Grapt. Quebec Group" (*Pl.* viii., *f.* 27—29).

Diplograpsus pristis appears first as a minute triangular body, with a microscopically slender axis *(Pl.* vii., *F.* 25*)*. The hydrothecæ are then developed along the free axis, which continues to grow faster than they are produced. Of *Diplograpsus tricornis* Mr. Carruthers says:—

"At the earliest stages the young specimens show all the characters of the adult. There is the solid axis continued above the polypary, and the three spines at the proximal end. At first a thin membrane is spread out between the spines and the slender axis at the distal end. Next there appear indications of the hydrothecæ, and these increase in number until the organism attains considerable size *(Pl.* viii., *f.* 26). The growth of other genera is somewhat similar. Young specimens of *Didymograpsus* have been found with merely a radicle and a single hydrotheca on each side. In most cases the first-formed thecæ are smaller than those afterwards formed, and do not increase in size."

In *Diplograpsus folium* the oldest thecæ continue small; but the young ones increase in extent by layers added to their apertures. We find a somewhat similar mode of growth in *Phyllograptus*. In *Cephalograpsus* the thecæ appear to elongate towards the proximal end, and after a short time do not increase in number, the young specimens having generally as many hydrothecæ as full grown individuals.

The development of many Hydrozoa is similar to that of grap-

tolites. In the Sertulariadæ, and also in the Corynidæ and Lucernariadæ, the new polypites are developed at or near the distal end of the cœnosarc, so that the distal polypites are the youngest. The hydrotheca is at first simply the cuticular investment of its polypite, represented in the young bud merely by the outer layer of the ectoderm; but gradually becoming "more and more widely separated from the body of the polypite, and eventually opening at its distal end to allow of the protrusion of the distal moiety of the polypite." (Huxley.) We can trace even this in the graptolite, for in the youngest specimens no apertures are visible. We see, therefore, that in their development, and, as far as we know, in their reproduction, as well as in structure, graptolites are nearly allied to Sertularian Hydrozoa.

In conclusion—Do graptolites throw any light on the question of the day—the Darwinian theory of the origin of species? Let us see.

The graptolite, a Hydroid zoophyte, has lived, and with it all its class has died. The whole race has completely disappeared, and for countless ages not a trace, not a single species of its class, has existed. Millions of years, it may be, pass away, and this class reappears—is re-created. Whence comes this recent class, the Hydrozoa? Can it have been developed "by means of natural selection," from its fossil progenitor, the graptolite, when for ages no Hydroid zoophyte has existed? Or can the graptolite have grown "by the pressure of external circumstances," out of its own humble class into another and a higher one, and then but recently, comparatively speaking, can this higher class have re-introduced, by natural selection (or "pangenesis"), the class from which it first originated? I think not.

No Darwinist, I think, could imagine a germ (or "gemmule") lying dormant from the Silurian to near the recent epoch, and then acting in the production of species as before. No Darwinist, again, would allow that a race could disappear and give place to a higher race, and that in its turn could evolve the same lower race from which it originally sprung. No! Each class has been specially created—created at its own appointed time, and to fulfil its own special purpose; and not only each class, but each order, each family, and, I believe, each genus. I will not presume to say, each species, for we cannot yet define the limits of a species.

Table showing the vertical distribution of the families and genera of the Graptolitidæ in Britain and in America :—

1—6, Lower Silurian. 7, Middle Silurian. 8 and 9, Upper Silurian.	BRITAIN.							AMERICA.					
	2. Skiddaw.	3. Arenig.	5. Llandeilo.	6. Caradoc.	7. Llandovery.	8. Wenlock.	9. Ludlow.	1. Potsdam.	2 and 3. Quebec.	4. Trenton.	5 and 6. Hudson.	7. Medina.	8. Clinton.
I. Monoprionidæ	—	—	—	—	—	—	—	—	—	..	—	..	..
Rastrites, Barrande	..	..	*	*	..	..	..	..	..	..	*	..	..
Graptolithus, Linnæus ..	..	?	*	*	*	*	*	..	?	..	*	..	*
Cyrtograpsus, Carruthers	..	..	..	..	..	*	..	..	..	..	..	..	..
Didymograpsus, M'Coy ..	*	*	*	*	..	..	..	..	*	..	*	..	..
Tetragrapsus, Salter	*	..	..	..	..	..	..	..	*	..	..	..	..
Dichograpsus, Salter	*	..	..	..	..	..	..	..	*	..	..	..	..
Cladograpsus, Carruthers	..	..	*	..	..	..	..	..	..	..	*	..	..
Dendrograptus, Hall	*	*	*	*	..	..	..	*	*	..	..	..	..
II. Diprionidæ	—	—	—	—	..	..	..	..	—	—	—	..	..
Diplograpsus, M'Coy	*	*	*	*	..	..	..	..	*	*	*	..	..
Cephalograpsus, Hopkinson	..	..	*	..	..	..	..	..	..	..	..	..	..
Climacograptus, Hall	*	*	*	*	?	..	..	..	*	..	*	..	..
Retiograptus, Hall	..	..	..	..	..	..	..	..	?	..	*	..	..
III. Monodiprionidæ.........	..	—	—	—	..	..	..	..	..	..	—	..	..
Dicranograptus, Hall....	..	*	*	*	..	..		..	..	..	*	..	..
IV. Tetraprionidæ	—	..	..	..	..	..	..	..	—	..	..	..	..
Phyllograptus, Hall	*	..	..	..	..	..	..	..	*	..	..	..	..

NOTE—In the above table I have inserted the figures showing the supposed equivalency of the graptolitic rocks of Britain and America from the evidence afforded by graptolites and the allied genera alone. The species afford more conclusive evidence of this correlation than the genera.

The Hudson River formation (5 and 6) includes the underlying Utica slate.

The following arrangement of the Hydrozoa is proposed by Mr. T. Hincks in his "History of British Hydroid Zoophytes."

Ord. I, HYDROIDA. Sub-ord. I, *Athecata* (Corynidæ). II, *Thecaphora* (Sertulariadæ). III, *Gymnochroa* (Hydridæ).

Ord. II, SIPHONOPHORA (Calycophoridæ and Physophoridæ).

Ord. III, DISCOPHORA (Lucernariadæ).

EXPLANATION OF PLATE VIII.*

1. *Rastrites peregrinus*, Barr. (original, from Moffat).
2. *Graptolithus priodon*, Bronn (a, from Murch. Siluria; b, d, and e, Geinitz, Die Grapt.; c, Carr., Intel. Obs., vol. xi.). b, side view of the polypary; d, back view showing solid axis partly removed; c, intermediate position; and e, front view, showing a section of the common canal and axis.
3. *G. Hisingeri*, Carr. = G. *sagittarius*, His. non Linn. (a and c, Nich., Geol. Journ., vol. xxiv.; b, original, from Builth).
4. *G. Sedgwickii*, Portl. *var.* (original, from Aberystwith). Associated with this species I have found fragments of *G. priodon* and of *G. Hisingeri*. From this I am induced to assign the rocks of Aberystwith to the Caradoc formation. The geological survey place them in the Llandovery. No fossils, except worm tracks, have previously been recorded from here.
5. *Cyrtograpsus Murchisoni*, Carr. (Carr., Geol. Mag., vol. vii.) This species is only known to occur at Builth, where I have found specimens.
6. *Didymograpsus Murchisoni*, M'Coy (a, original, from Llandrindod, Builth; b, Baily, Brit. Foss., slightly altered).
7. *Tetragrapsus bryonoides*, Salt. (Hall, Grapt. Queb. Group).
8. *Dichograpsus octobrachiatus*, Hall (Hall, op. cit.). With corneous disc.
9. *Cladograpsus linearis*, Carr. (a, Murch. Sil., ed. iv.; b, Carr., Int. Obs.).
10. *Dendrograptus Hallianus*, Prout. (Hall, op. cit.)
11. *Diplograpsus pristis*, His. (a, Carr., Geol. Mag., vol. vii; b, enlargement of a narrower specimen, original, from Moffat).
12. *D. penna*, n. sp. (original, from Moffat). The fracture shown at c, must, I think, have taken place during the deposition of the sediment in which this curious specimen is preserved.
13. *D. folium*, His., a young specimen (original, from Moffat).
14. *Cephalograpsus cometa*, Gein. sp. (a, and c, Carr., op. cit.). The enlarged figure is intended to show the general structure of the polypary. I have not examined the species microscopically, and therefore cannot say that this drawing is *quite* correct.
15. *Climacograptus scalaris*, Linn. *et* Hall (a, Carr., op. cit.; b, c, and d, original, from Moffat). The enlarged figures show the different positions in which this species is preserved.
16. *C. bicornis*, Hall (Hall, op cit.). c, the proximal end of a young specimen showing a well developed radicle, × 2 dia; d, the proximal end enveloped in a corneous disc.
17. *Dicranograptus ramosus*, Hall (op. cit.). At b, the pustules referred to, are shown; and on the *left* of c, are the apertures of the hydrothecæ.
18. *Phyllograptus angustifolius*, Hall (op. cit.).
19. Diagram showing the structure of the genus *Climacograptus* (Hall, op. cit.), × 8 dia. The division between the hydrothecæ separates them entirely until it approaches the axis, when it gradually becomes narrower, allowing the cænosarc to communicate freely between all the polypites.
20. Horizontal section showing the structure of the genus *Phyllograptus* (op. cit.).
21. Young specimen of *Climacograptus* (original, from Moffat).

22—25 Germs of various species (original, from Moffat).

26. Young specimen of *Diplograpsus tricornis* (Carr., Int. Obs., vol. xi.).
27. Germ of a diprionidian species. No hydrothecæ apparent (Hall, op. cit.).
28. Germ of a diprionidian species. Hydrothecæ partially developed (op. cit.).
29. Germ of a similar species, fuller grown. Hydrothecæ more developed (op.c.).
30. A fragment of the periderm of *Diplograpsus Whitfieldi*, showing a gonotheca, or reproductive sac, from which two germs are just escaping (op. cit.).

* All the figures marked a, and also 1c, 3c, 14c, 16d, 20, and 26 are natural size. All marked b, and also 2c and d, 12c, 15c and d, and 17c, are enlarged 4 diameters. 2e, 21, and 27–29, are × 6; and 22–25, 12 diameters.

Bunt Spores. By M. C. Cooke.

(*Read February 26th*, 1869.)

I am induced to bring this subject before the Club, primarily on account of the prominence given to Bunt Spores in Professor Hallier's works on Cholera Contagion, and, secondly, because they are useful and instructive objects for microscopical examination.

Bunt (*Tilletia caries*) is a parasitic fungus which entirely replaces the farinaceous interior of grains of wheat, and fills the entire husk with a dark brown, impalpable powder, resembling soot. This powder consists of brown globose spores, with a reticulated surface, sparingly intermixed with delicate branched threads. Externally the ear of wheat, when affected, differs so little from a healthy ear of wheat, that only an experienced eye would detect the difference. The grains themselves are a little swollen and darker coloured, but still retain the form of the grain. When broken between the finger and thumb, a rather fetid odour is perceptible, which led to the adoption of *Uredo fœtida* as one of its older names.

This diseased condition of wheat has certainly been known for more than a century, since Matthieu Tillet wrote his "Dissertations" in 1755, and from him its present generic name is derived.

It is no portion of my duty to refer here to the agricultural features of this "foe to the farmer," or to the means adopted to check its ravages, but rather to indicate briefly its microscopical character and development.

In the year 1847, the Rev. M. J. Berkeley instituted some important experiments on Bunt Spores, and published the results in the second volume of the "Journal of the Horticultural Society of London," in a paper entitled "Observations on the Propagation of Bunt, made with an Especial Reference to the Potatoe Disease" (pp. 107). As this paper contains the first indication of the true character of Bunt Spores, I may be excused for quoting from it freely.

"I procured," says the writer, "as good a sample of wheat as possible, and divided it into two portions, washing the one care-

fully, and then sowing it with every precaution, that there should be no contact with any of the spores of the bunt with which I was experimenting; the other portion was steeped in a thick mixture of bunt and water, a portion of the black liquor being poured on the surface of the soil after the impregnated grains were sowed; the progress of the grains and spores was then daily examined. The clean wheat sprang up as usual; but there was soon an evident difference in the infected grains—a difference which was distinctly visible till the ears were perfectly developed, when every infected plant was bunted, while from the unimpregnated seeds, not a single bunted ear was produced. In one of the bunted plants not only the ear was diseased, but there was a streak of bunt upon the stem, in which the fetid smell and peculiar structure were not to be mistaken, a circumstance which I have never before observed, nor am I aware that the fact has been noticed by others, and confirmatory of the opinion that the disease is not a mere alteration of structure in the grains of fecula, were such testimony wanted.

" Four days after sowing I found that the spores of the Uredo (*Tilletia*) had been sucked in, doubtless by capillary attraction, between the young root and its investing membrane, which was ruptured, germination at that period having scarcely taken place. The spores were quite as large as either of the two distinct series of cells of which the young root is composed.

" Three days later I perceived the first traces of germination in the spores. A little obtuse tube, thicker than the pellucid border of the spores, in a very few instances only, and appearing like a short peduncle, scarcely so long as their diameter, was protruded through the external membrane. This surprised me extremely, because on the mass of spores, whether on the surface of the soil or on the grains of wheat, there was a white, very delicate, extremely short down. On a closer examination, the greater part of the grains of bunt were found to be clothed on one side, with fascicles of white filaments, from two to four times longer than the diameter of the bunt spores, and producing towards their apices extremely long and slender, somewhat curved, acuminate, multiseptate spores.

" Three days later a large portion of the grains of bunt were ruptured, either irregularly or in a stellate form; a few more had germinated, the filaments being evidently protruded from the internal membrane, and either straight or curved, and occasionally branching off in two opposite directions, the tips of the threads

being in all cases very obtuse, and many times larger than the intercellular cavities of the tissue of the roots.

"The parasite, meanwhile, had undergone a very curious change, the spores being no longer separate, but connected with one another by one or more short transverse tubes, exactly as in the threads of *Zygnema*.

"Two days later many more of the bunt spores were ruptured, and the mycelium more elongated; and after three more days the parasite was vanishing, and scarcely visible any more *en masse* to the naked eye, while the mycelium had increased to the length of six or more diameters of the spores. The young infected wheat plants were now evidently diseased, the sheaths and base of the leaves looking crumpled, and spotted either with white or brownish specks, and the whole appearance less healthy than that of the unimpregnated plants.

"The diseased sheaths were now, in most cases, full of mycelium, but no such appearance was visible in the healthy state. Though the disease had evidently commenced, it is to be observed that the tubes protruded by the spores were but slightly developed, and that though the utmost pains were taken, I could trace no connection whatever between these and the diseased tissue.

"In a single instance only, ten days after the first appearance of disease, in examining some little white specks which appeared on the leaves of the bunted wheat, I saw a curved filament passing through one of the stomata, but whether from the outside to the inside, or the contrary, I cannot say. The mycelium in these white specks was not abundant, but thicker than the walls of the cells.

"In a month from the sowing of the wheat, the fecula of the grains being then nearly absorbed, it was difficult to find any spores, and no further development of mycelium directly from the spores had taken place.

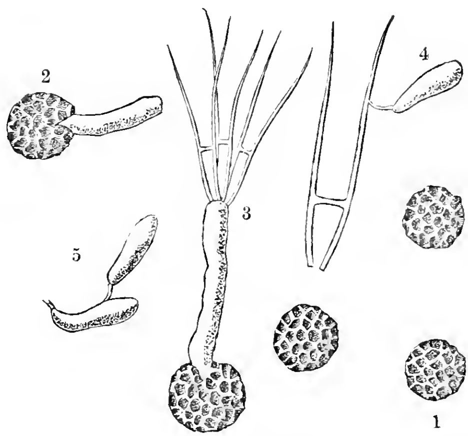
"The first bunted ear appeared four months from the time of sowing, and while every impregnated plant produced bunted ears, not a bunted grain appeared on the plants which sprang from uninfected seed.

"The production of the parasite on the spores of bunt was constant in my experiments, and was repeated at Bristol and Clifton under the eyes of Mr. Thwaites and Mr. Broome, to whom I had communicated bunted grains of wheat. I was at first inclined to think that *it had something to do with the reproduction of the bunt,*

and it is quite possible that in plants, as well as in the lower animals, *there may be an alternation of generations.* This is, however, merely thrown out as a hint which may be followed out by those who have fewer avocations than myself. Many anomalous appearances, amongst algæ, especially, seems to indicate something of the kind."

Mr. Berkeley then proceeds to characterise what he deemed the parasite of the germinating Bunt Spores, under the name of *Fusisporium inosculans.*

This paper, which is accompanied by a page of illustratrations, was communicated on the 18th January, 1847.



1. Bunt spores (magnified 400).
2. Bunt spore germinating.
3. Producing spores of the second generation (conjugated).
4. Spores of second generation conjugated, and producing spore of third generation.
5. Spore of third generation producing spore of fourth generation.

In the Annales des Sciences Naturelles for 1854, Mons. L. R. Tulasne, in "a second memoir on the Uredines," showed that *Tilletia caries* in the course of its development passed through a veritable alternation of generations, and that the long fusiform bodies, described by the Rev. M. J. Berkeley, under the name of *Fusisporium inosculans*, were the bunt spores of the second generation, which in their turn produced long elliptical spores of the third generation, which in their turn produced also similar spores of a fourth generation.

Hence what Mr. Berkeley had barely suspected in 1847, was in 1854 shown to be true.

In his "introduction to Cryptogamic Botany," Mr. Berkeley alludes to his experiments on bunt, and the suspicions he entertained, for writing of the bunt spores, he says *(p. 321)* :—"The spores, however, are not immediate means of propagation; they are, in fact, only a sort of prothallus, from which the mycelium grows, producing at the tips, or on lateral branchlets, bodies of various forms, which are themselves capable of germination, and immediately reproduce the species. These bodies were, I believe, first observed by myself in *Tilletia caries*, though with nothing more than a suspicion of their real character. I found that whenever the spores of Bunt germinated, linear or fusiform bodies were generated, which ultimately became joined after the fashion of *Zygnema*; and Mr. Broome and Mr. Thwaites on repeating the experiment at my request obtained the same result. In my uncertainty as to their real nature, they were described and figured as *Fusisporium inosculans* in the transactions of the Horticultural Society of London, and in the Encyclopædia of Agriculture, under the word "Bunt."

Passing from the germination and propagation of Bunt to its supposed connection with cholera, we may remember that many years ago, when the examination of cholera evacuations were said to indicate a fungoid origin, and much was written and said about the influence of Fungi spores in producing cholera; if I remember rightly, some of these spores were submitted to Mr. Busk, and he pronounced them Bunt spores, which, at that time more commonly than now, were often found in flour and bread, and by the natural course of eating found their way into the human intestines.

Last year Professor Hallier, in his "cholera contagium," again raised the cry that cholera was caused by a fungus, but in this instance one which he assumed to be parasitic on rice in India, identical with one found in Europe on the leaves and sheaths of rye, and known as *Urocystis occulta*. Unfortunately for himself and his theory, the learned Professor assumed too much. It could not be proved that the *Urocystis* attacked the grain of any food plant at all, or that it had been detected on the leaves of the rice plant. A long article favouring Dr. Hallier's views appeared in the "Standard," the fallacies of which I attacked a few days after in the columns of "Country Life." With almost as great facility

as he laid hold of *Urocystis* did Dr. Hallier renounce it, and now, no longer believing it to be the cause of the mischief, he transfers all his condemnations to bunt spores (*Tilletia caries*), as will be seen by his recent work on "Phytopathology," and the reports of Drs. Cunningham and Lewis in the "Lancet," of January the 2nd, 9th, and 16th.

The entire foundation of Dr. Hallier's theory is an assumption that moulds are related to Ustilagines, or "smuts and bunt," or to use his own phrase, that "moulds are mere unripe forms of Ustilagines." In this assumption I am not at all disposed to concur. The fact itself must first be proved, and this has not been done. It is not only possible, but probable, that some of the moulds are conditions of Mucors, as in the case of *Verticillium* and *Acrostalagmus*, and it may be of *Aspergillus* and *Mucor* or *Ascophora;* but the relations between either *Penicillium crustaceum*, or *Mucor racemosus* and *Tilletia caries* must be very remote, or, if not remote, not proven. Already some persons have accepted the conclusions of Dr. Hallier, without thought or question, and argued therefrom that there is no sound basis of classification in Fungi at all, that the whole study is a chaos, and that a new apostle has arisen at Jena to the discomfiture of mycologists all the world over, who is destined to overturn and scatter to the winds all the labours of Fries, Corda, Montagne, Preuss, De Bary, and Tulasne.

The theory that is to accomplish this is thus stated:—"If the spores of an *Ustilago* be cultivated, two forms always appear—viz., the schizosporangic and the cladosporic forms; if the soil on which any of these forms appear alters or ferments, the forms produced are different. He states that each species of Ustilago has three ripe forms of fructification, and that each of these has a corresponding unripe representative, the use of the unripe form being probably, according to Professor Hallier, to prepare a more nitrogenized soil on which the higher forms may be developed. If *Tilletia caries* be cultivated on weak, poor soil, we get only unripe forms—*i. e.*, moulds make their appearance.

These ripe and unripe forms may be thus tabulated, taking as an example the fungus associated with cholera:—

UNRIPE.	RIPE.
1. Macroconidia	1. Tilletia caries
2. Penicillium crustaceum	2. Cladosporium
3. Mucor racemosus.	3. Schizosporangium.

The ripe forms are distinguished from the unripe ones by having a cuticula developed, which makes them much more resistant.

I am not intending to enter upon an examination of this theory, or Professor Hallier's propositions. This is not the time or place for either. All I desire to do is to show the connection between Bunt Spores and the cholera controversy, as an apology for bringing the subject before the Club. I would commend Professor De Bary's observations to the consideration of all who favour Hallier's views, and, as a humble student, I would protest against assumptions being accepted as facts, and deny that Dr. Hallier has proved by his experiments that bunt spores have any connection whatever with mucors or mucedines, and consequently, as he admits, that his whole theory is *based* on the supposed fact that "moulds are mere unripe forms of Ustilagines," therefore his theory is without even a plausible foundation.

In order that this brief communication may be more complete, I have added as an appendix the synonyms under which bunt, or *Tilletia caries* has been known to botanists, and also a list of such books, treatises, or papers on Bunt as I could remember, which might be of service to any one desirous of continuing the subject.

SYNONYMS.

Tilletia caries—Tulasne Ann. des Sc. Nat., 1847. Vol. vii., pp. 113, pl. 5, fig. 1—16.
Uredo caries.—D. C. Flor. Franc. Vol. vi., p. 78.
Tessier mal des grains, p. 217.
Uredo fœtida—F. Bauer in Ann. Sc. Nat., 1824. Vol. ii., p. 167, pl. 7, fig. 17—20.
Uredo segetum—Pers. syn., p. 225.
Uredo decipiens—Str. Ann. der Wett., 1811.
Uredo oblongata—Ditmar in Sched.
Uredo sitophila—Ditmar. Deutsch., Flora.
Uredo sphærococca—Rabh. Deutsch., H., No. 17.
Cæoma segetum—Nees. Syst., pp. 15, pl. 1, fig. 17.
Cæoma sitophilum—Link. Spec. Vol. ii., pp. 2.
Erysibe fœtida—Wallroth, Flor., Germ. Vol. ii., pp. 213.
Erysibe folliculata—Wallr. in Verhandl. nat. Frde, i. p. 19.
Erysibe sphærococca—Wallr. Flor. Germ. Vol. ii., pp. 213.
Ustilago caries—Dur. and Mont., Fl. Alger, i. pp. 302.
Ustilago tritici—Buxb. Fl. Hal. p. 342.
Ustilago frumenti—Plan. Disput., 1709.

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Memoir on a New Form of Binocular Microscope. By Samuel Holmes.

(Read by Mr. George, January 22nd, 1869.)

Some time previous to the introduction of the Binocular Microscope by Mr. Wenham—I think in the year 1858—I had been engaged with the subject of a stereoscopic microscope myself and being familiar with Mr. Wenham's former experiments, I came to the conclusion that some use might be made of the property of total reflexion from a glass second surface, instead of using any refracting arrangement.

I now propose to describe to the meeting an incomplete experiment on this basis, which I ceased to prosecute on the appearance of Mr. Wenham's beautiful Prism Binocular.

Now although this experiment of mine has been so long laid aside—there was no Quekett Club in those days—I am still of opinion that the scheme is worthy of further trial, and I have been induced to bring the matter before the meeting by reading the excellent remarks on the requirements of Binocular Vision in the reported speech of Mr. Durham.

In this microscope I propose to divide the light from the object glass into two portions, and to direct one half into each eye through the medium of two reflectors and two eye-pieces, so as to gain a more perfect knowledge of the structure observed, while such observation shall be less fatiguing, being conducted by two eyes whose optical axes are equally inclined. The object glass consists of an hemispherical plano-convex lens, the plane side of which is either ground off or ground into, two facets, representing the angle of stereoscopic vision. This lens is placed over the object with its obtuse, or its re-entrant angle—according to which form is used—of its face, at an angle of 45° to the perpendicular, in which direction the rays from the object reach it, to be divided and reflected horizontally to the eyes through two converging eye-pieces.

There is thus, first a plano-convex lens, to receive and amplify the object; secondly two plane mirrors, for reflecting two distinct and angular half-field views of the object stereoscopically, and lastly a secondary plano-convex lens for still further increasing the ap-

parent magnitude of the two images, and finally projecting them into the respective body tubes of the instrument. But as in the concrete form, both *lenses* and *reflectors* are entire, they have but two common surfaces, instead of six, and will not therefore introduce any indistinctness by secondary reflection, for the rays traverse the same solid medium until their final emergence, and further the angle of inclination is such as to act by total reflection and thus the illumination of the image is not weakened by the change of direction.

The smallest amount of spherical aberration attends this position of a thick plano convex lens, and the evils arising from bad centring cannot exist, for the surfaces of both lenses are ground in the same tool, and are in fact, but contiguous prolongations of the same surface. This angular position of a hemispherical plano-convex lens was first proposed by the late Sir David Brewster, only for doubling its magnifying power, and for use as a diagonal eye-piece, *but by the addition of an angulated surface the duplication of the image is secured* for projection through binocular eye-pieces.

If the angulated surface is cut *into* the lens, the resulting image should be pseudoscopical; but if the surfaces are made by cutting *off* the lens, the right eye will receive the left-hand image and *vice versa*, and the result should be a stereoscopic representation of any opaque object under notice.

I am sorry to say that I cannot exhibit to the meeting a complete instrument on the plan suggested, but I must content myself with offering for inspection the lens I have experimented with.

It would not be difficult to render such a lens achromatic, by a flint concave, and any magnifying power may be had by screwing on, underneath the reflecting lens, the ordinary objectives.

This lens, it will be observed, I have made of two pieces, and cemented them together with Canada balsam, because difficulties of construction leave no means to make it of one piece. Perhaps it should have been joined by some black opaque cement, to ensure complete isolation of each semi-field of light.

12, *Brunswick Terrace, Lower Road, Rotherhithe.*
November 9th, 1868.

NOVELTIES.

Moginie's Collecting Case.—A new form of collecting case has been recently brought before the Club by Mr. Moginie, of 35, Queen Square. It is intended to accompany his well-known collecting stick and apparatus, introduced some time since. It is made of stiff leather, lined with baize, and contains three strong bottles ("York" pattern) of the size best adapted for use with the collecting stick, and four smaller bottles. There is also a screwed ring for attaching each of the larger bottles to the stick, a space for the steel cutting hook for gathering aquatic plants, and a small magnifying lens, mounted in horn. The case is made to open like a portmanteau, so that each bottle is easily got at, and no space wasted. The whole is very portable, and is easily carried by means of a strap over the shoulder. The article can be supplied for twelve shillings, or, with the collecting stick, &c., for one guinea.

Porcelain Lamp Shade.—This has been introduced by Mr. Hailes, and consists of a short cylinder of unglazed earthenware, blackened on the outside, and for a short distance from the top, inside. It is of sufficient size to drop easily over the chimney of the lamp, and rests upon a gallery attached to the burner, or is held by a projecting arm from the stem of the lamp stand. There is a portion of the lower part cut away on one side, large enough to allow the light to pass in the required direction. Its small size renders it very convenient for travelling lamps, and the material being white the interior forms a very efficient "white cloud" reflector. We believe that the cost will be very small.

Plate for Shewing Compression and Flexure of Glass.—Those who have studied the phenomena of polarized light are acquainted with the remarkable de-polarizing effect produced by glass in a state of unequal tension. This is often effected by rapidly cooling pieces of glass of various forms, which, when examined by polarized light, exhibit the effect produced by varying shades of colour of more or less intensity. But the effect may be shewn, and the cause demonstrated by arranging a piece of glass in such a manner as to render it possible to apply pressure, and so bring the particles of the glass into a condition of unequal tension, while under observation. Mr. Bailey, of Fenchurch Street, has reduced the size

of the apparatus necessary for the purpose, so that it may be laid on the stage of the microscope. The necessary pressure being applied by means of a screw, waves and clouds of colour are seen to start out in directions which depend on the amount of force, the ex tent of surface over which it is applied, and the power of resistance.

QUEKETT MICROSCOPICAL CLUB.

DECEMBER 18TH, 1868.

ARTHUR E. DURHAM, ESQ., PRESIDENT, IN THE CHAIR.

The minutes of the preceding meeting were read and approved.

The following donations were announced:—

"Science Gossip," from the Publisher; "Land and Water," from the Editor; "Proceedings of the Bristol Natural History Society," from the Society; "The Naturalists' Circular," from the Editor; "The Chemical Geology of the Gold Fields of California" (read before the Royal Society), from the author, Mr. J. A. Phillips; two slides (Sections of Pearl and Heliopelta), from Mr. Curties; and a quantity of unmounted microscopical specimens, from Mr. Eldridge.

The thanks of the members were returned to the respective donors.

The following gentlemen were proposed for membership:—Mr. J. H. Allder, Mr William Brookes, Mr. Alfred Deed, Mr. Basil E. Greenfield, Mr. J. Harper, Mr Louis Lewis, Mr. M. Pillischer, Dr. W. H. Sheehy, Mr G. Webb, Mr. C. E. White.

Sixteen gentlemen, proposed at the previous meeting were then elected by ballot.

The following objects among others, were announced for exhibition:—Marine Dredgings, by Mr. Curties; Gemmules of Sponge, by Mr. Groves; Orchisella pilosa, by Mr. McIntire; and nine pen and ink drawings, from Microscopical objects, executed by Mr. Hammond, and exhibited by Mr. Moginie

Mr. John Hopkinson then read a paper "On British Graptolites," for which the thanks of the meeting were unanimously voted.

Mr. Samuel Roberts exhibited and described a new form of micrometer.

The arrangements for Mr. M. C. Cooke's and for Mr. Suffolk's classes were announced, and after the usual conversazione the meeting separated

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JANUARY 22ND, 1869.

ARTHUR E. DURHAM, ESQ., PRESIDENT, IN THE CHAIR.

The minutes of the preceding meeting were read and approved.

The following donations were announced:—

"Science Gossip," from the Publisher; "The Popular Science Review," from

the Publisher; "Scientific Opinion," from the Editor; Report of the Liverpool Naturalists' Field Club, from the Club; three slides from Mr. Quick, and sixteen slides of different varieties of Hippuric Acid, from Mr. Hislop.

The thanks of the members were returned to the donors.

The following gentlemen were proposed for membership :—Mr. W. Atkinson, Mr. R. Crafer, Mr. F. Evans, Mr. C. J. Fricker, Mr. A Hammond, Mr. J. W. Harker Mr. C. Lavey, Dr. T. Prichard, Mr. W. Warner, Mr. F. W. White.

Ten gentlemen proposed at the previous meeting were then duly elected.

The President reminded the members of an announcement at a previous meeting that a Microscopical Society had been formed at Liverpool on the same basis as the Q. M. C. The new Society had met with great encouragement, and a number of influential persons in Liverpool had joined it. The Honorary Secretary of the Club (Mr. Bywater) had been elected the first honorary member of the new society as an acknowledgment of the assistance he had given at its formation.

Mr. M. C Cooke also announced the formation of a Microscopical Club at Chicago on the same basis as the Q. M. C., which it recognised as its parent society. Mr. Cooke also stated that his class for the study of Microscopical Fungi would commence on the following Tuesday evening. If successful the lectures would probably be repeated in the autumn.

A variety of objects were announced for exhibition, among which were the Leg of a Diamond Beetle, with pseudo-scopic prism, by Mr. Crouch, and Spores of the Bramble Brand, by Mr. Marks.

Mr George read a paper by Mr. Samuel Holmes, "On a new form of Binocular Microscope," which was illustrated by diagrams and a prism, no complete instrument having been finished.

Mr. Suffolk read a paper "On some of the means of delineating microscopical objects"

The author received the thanks of the meeting for his paper.

Allusion was made by Mr. Johnson to a method of delineating microscopic objects (described in "Science Gossip") by throwing the image upon a piece of ground glass, and then tracing it with a pencil, a kind of camera being made of a cigar box.

Mr. T. C. White suggested that if at the end of the cigar box a piece of looking glass be set at an angle of 45°, and a piece of clear glass be placed above it so that the image was reflected up through it, a piece of tracing paper could be laid on the upper glass and the tracing made at once.

Mr. McIntire said that in drawing from living objects he had found it best to make a number of rough sketches on card, and from these to make a drawing. If this drawing were then placed on the stage by the side of the object, and, the prism withdrawn, the object and drawing were seen side by side, and a comparison easily made.

The President remarked that he thought that the "cigar box" was the best way of obtaining accurate outlines. Instead of ground glass, if a piece of plain glass was used, thin paper might be placed against it, and the object could be drawn at once. If the eye-piece were in, the eye-piece micrometer might be used.

The President announced that the Annual Soirée would be held on March 12th, for which date the Council of the College had kindly granted the use of the building.

FEBRUARY 26TH, 1869.

ARTHUR E. DURHAM, ESQ., PRESIDENT, IN THE CHAIR.

The minutes of the preceding meeting were read and approved.

The following donations were announced :—

"Proceedings of the Bristol Natural History Society," from the Society; "Scientific Opinion," from the Publisher; "The Monthly Microscopical Journal," for January, from the Publisher; "Science Gossip," for February and March, from the Publisher; a Pamphlet, relating to the Electric Telegraph (reprinted from the "Scientific Review"), from the Publisher; two slides from Mr. Curteis, and two slides from Mr. W. H. Golding; for which donations thanks were duly voted.

The Honorary Secretary for Foreign Correspondence (Mr. M. C. Cooke) announced that through the influence of an American correspondent, the Rev. E. S. Bolles, with Dr. Woodward, the Surgeon-General of the United States Army at Washington, a series of micro-photographs had been forwarded for presentation to the club. The series consisted of about thirty mounted pictures, comprising a series illustrative of the effects of high powers upon one of Nobert's test plates, and another series illustrating the Diatomaceæ.

The President remarked on the extremely perfect and beautiful character of the photographs, and a vote of thanks was unanimously accorded to the donor.

The following gentlemen were proposed for membership:—Mr. Josias Alexander, Mr. C. Bennett, jun., Mr. F. Blankley, Rev. R. Blight, Mr. E. Clark, Mr. G. Conder, Mr. J. W. Gann, Mr. Marshall Hall, F.G.S., Mr. L. Jones, Mr. T. W. Kirby, Mr. Henry Lee, F.L.S., &c., Mr. F. Stokes.

Ten gentlemen proposed at the previous meeting were then duly elected.

A number of objects were announced for exhibition, among which were a microscopic fungus, *Aregma Mucronatum*, on rose leaf, by Mr. Groves; Flea of Mouse in Glycerine, by Mr. McIntire; Coccus of the Orange, by Mr. Oxley, &c.

Mr. James Jordan read a paper "On the Preparation of Rock Sections for Microscopical Examination." The paper was illustrated by diagrams, and by specimens in various stages of preparation.

A vote of thanks was unanimously accorded to the author.

Mr. Breese said that he had found great inconvenience in consequence of the lubricating material being constantly thrown off by centrifugal force. To obviate this he had converted his slitting disc into a ring or annulus, supported on another ring or collar, so that he could apply the stone to be slit to the inner circle of the ring. The internal portion then formed a sort of reservoir, which retained the lubricating material.

Mr. M. C. Cooke read a paper on "Bunt Spores." The paper was illustrated by diagrams.

The President considered that the meeting was much indebted to Mr. Cooke for his paper on a subject which was interesting, not only to the Botanist, the Fungologist, and the Pathologist, but also to all who were interested in those conditions of life of which the Pathologist treats. The cordial thanks of the members were then returned to Mr. Cooke.

Mr. H. F. Hailes exhibited a new form of porcelain shade for a microscope lamp.

Mr. Curties called attention to a beautiful series of drawings of Entomostraca and Infusoria, by Messrs. Clayton and Tatem.

Mr. Moginie exhibited a new form of portable case for collecting bottles.

The President called attention to the approaching soirée, and expressed a hope that the members would form the majority of exhibitors.

In answer to a question by Mr. Golding, the President said that, subject to the consent of the Council, the extra meetings would be continued on the second Friday in each month.

The proceedings terminated as usual.

EXTRA MEETINGS.

These meetings have proved entirely successful, and the experiment has developed so much interest on the part of the members that the Committee propose to continue them. It is desirable that notice should be taken of the date, as the mistake has been made of announcing the meetings of the Club as being once a fortnight, whereas they take place on the *second* and *fourth* Fridays in each month, except Christmas Day or Good Friday. At these extra meetings for exhibition of objects and conversation an average attendance of 70 members has been noted; there has been no lack of instruments, and the objects shewn have been most varied and interesting. Want of space prevents enumeration in the present number, but an early opportunity will be taken of noticing subjects of importance.

ANNUAL SOIRÉE.

The Annual Soirée of the Club was held on Friday, March 12th, and afforded a remarkable indication of the increasing interest felt in microscopic pursuits. By the courtesy of the Council and the kind assistance of Mr. Robson, the secretary, the resources of University College were made available for the occasion. Nearly fourteen hundred ladies and gentlemen were present during the evening. The exhibitors were also numerous, about 230 microscopes being contributed—140 by private members of the club, and the remainder by opticians. These, with drawings, photographs, specimens of Natural History, and other objects of interest, were distributed in the library and museum. Three rooms were reserved for the exhibition of the phenomena of Polarised light, Kaleidoscopic effects, and Micro-photographs by Mr. How; some interesting views of Abyssinia from the Stereoscopic Company, by Mr. Martin; and microscopic photographs, pictures, &c., by Mr. Highley, all of them being shown by the lime-light, projected upon a whitened screen. An endeavour was made to obtain details of the objects to be shewn some days previously to the meeting, and all

the particulars which were obtained in time were arranged in the form of a Synopsis, setting forth the name of the object, with that of the exhibitor, and indicating the number of the table at which it might be found, accompanied by a plan of the rooms, upon which the tables were shewn, with their numbers appended. It would be impossible and unnecessary to particularise the large collection of objects shewn, but especial attention was given to some remarkably beautiful Sections (longitudinal and transverse) of the Spinal Cord, which showed very perfectly the ganglion cells and nerve-fibres, and their mutual relations. These preparations were exhibited by Mr. Durham, and were made by Mr. A. B. Stirling, of the Anatomical Museum, Edinburgh, and assistant to the late Professor Goodsir. Mr. J. B Jordan exhibited Sections of Crystallised Rocks; Polarised Crystals were shewn by Dr. Dempsey, Messrs. Brabham, Hislop, and T. C. White; selected Diatoms and Polycystina, by Dr. Dempsey and others; living Cheyleti and Poduræ, by Mr. McIntire; and a beautiful collection of drawings, Infusoria, Entomostraca, &c., by Messrs. Tatem, Clayton, and Draper, were exhibited by Mr. Curties.

The opticians who exhibited instruments, apparatus, and objects were Messrs. Bailey, Baker, Collins, Crouch, Horne and Thornthwaite, How, Mogiuie, Newman, Newton, Powell and Lealand, Ross, Smith and Beck, Steward &c.

The company did not entirely separate till a very late hour.

THE JOURNAL

OF THE

Quekett Microscopical Club.

On Some of the Means of Delineating Microscopic Objects. By W. T. Suffolk.

(Read January 22nd, 1869.)

[Abstract.]

I have been induced to bring the subject of microscopical drawing before the club, principally because the idea prevails that the production of representations of objects viewed under the microscope is attended with unusual difficulty. Certainly, this is the case with elaborate representations, especially of objects as they appear under the binocular microscope. But the production of drawings, both truthful and of great utility as records of observation, is by no means so difficult as it is supposed to be. We cannot all expect to equal the minutely accurate drawings and lithographs of Tuffen West, the delicate representations of tissues by Dr. Beale, so ably interpreted on wood by Miss Powell, the marvellously accurate figures by Richard Beck, reproduced by some talented engraver, whose name is unknown to me, but whose work I none the less admire—or the wood blocks engraved by our own member, Mr. Ruffle; but I think almost any microscopist might be able, with the aid of some one or other of the instruments I am about to describe, to make useful records of his own observations—rough, possibly in execution, but still much more truthful than drawings made by a more skilful but less scientific artist.

Photography is, under certain conditions, undoubtedly the most perfect means of obtaining representations of microscopic objects; but, unfortunately, these conditions limit, to a great extent, its

application. In order that a microscopic object should yield a good photograph, it is necessary that it should be very thin, so that the greater part of it can be brought into focus at once, the reduction of aperture practised successfully by landscape and other photographers not being available here on account of the great loss of light caused by the use of small diaphragms. It is also requisite in the present state of micro-photography that the object should be such that all its details can be brought out by transmitted light, and should be colourless, or at any rate of a colour not hindering the transmission of the chemical rays of the spectrum. These conditions, at present, limit very much the application of photography to microscopic purposes; and the necessity of employing special apparatus, and mastering a somewhat delicate set of chemical processes, will ever prevent its extensive employment. The photographs by Dr. Maddox, and those issued by the Medical Department of the United States Army, show well the capabilities of the art,—the markings of the Diatomaceæ being represented with a minuteness and accuracy so great, that photographs on glass will bear a considerable amount of enlargement, by means of the magic lantern. There is exhibited this evening on one of the tables, a beautiful series of micro-photographs, taken and presented to the club by our President, which will enable those who are at present unacquainted with the results attained in this department of art to judge of its merits for themselves.

Drawing without auxiliary instruments is only available to experienced artists, and is defective on account of its giving no key to the dimensions of the object. It is chiefly of use for rough notes and living objects in motion, where instruments would be of little service.

The principal drawing instruments attached to the microscope are Dr. Wollaston's camera lucida, Sœmmering's steel mirror, and the neutral tint reflector. These are mostly contrivances by which the pencil and the paper and the image of the object are rendered visible together, and apparently blended. This can be effected in two ways. First, as in the camera lucida, Sœmmering's steel mirror, and Nachet's instruments, by viewing the image of the object with one portion of the pupil of the eye, and the paper and pencil with the other. Second, as in the neutral tint reflector, where the pencil and the paper are viewed through the inclined mirror, which at the same time reflects the image of the object.

Sœmmering's mirror I have never used, and cannot, therefore, speak of it from experience. Tinted reflectors are pleasant to work with, but reverse the image, and it is necessary to use a reflecting prism for the completion of the drawing. They are not available for the binocular instrument on this account.

Wollaston's camera lucida, on account of its double reflectors, does not reverse the image. It is rather troublesome to use on account of the constrained position of the eye, but it is indispensable when a drawing is to be highly finished, especially with the aid of the binocular.

Finding the horizontal position of the microscope troublesome, inasmuch as it disturbed the illumination used for observation, I thought that the old principle of enlarging and reducing drawings by squares might be applied to microscopical purposes. Messrs. Beck supplied me with a ruled disc to be placed within the eye-piece in the focus of the eye-glass, so that the field appeared to be ruled in squares, and which very much facilitated the taking of a sketch, by merely using a paper ruled in squares of a convenient size. This process is, to a person used to drawing, much more convenient than any of the other processes, as it in no way hinders the arrangement of the instrument or its illumination.

On an Improved apparatus for the preparation of Rock Sections for Microscopical examination. By James B. Jordan.

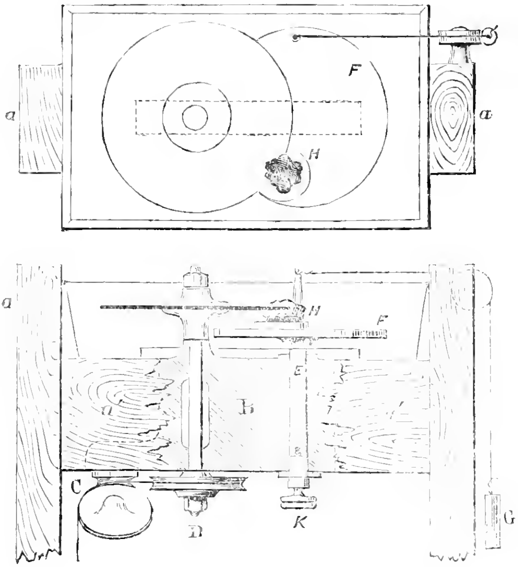
(*Read February 26th,* 1869.)

To describe with accuracy the mineral composition of a given rock is often a task of considerable difficulty, especially if the individual minerals occur only in minute crystals or in granular masses, and are so intimately associated as to show to the naked eye only a fine grained appearance. Such rocks nevertheless frequently fall under the notice of the geologist, who of course gladly avails himself of any aid—whether chemical, physical, or mechanical—which may assist him in his examination. Among these aids there is none more important than that offered by the microscope. By studying sections of sufficient thinness to admit of examination by transmitted light, considerable insight is gained as to the character of the component minerals of the rock and their mode of association; whilst the value of such observations may be increased by introducing the use of polarized light.

The subject of thus preparing thin sections of hard material has been fully treated by Mr. Sorby, and also by Mr. David Forbes. At the request, however, of our secretary, I venture to bring it before you this evening, for the benefit of those who are interested in this branch of microscopical science.

Having had occasion to cut and grind a series of geological specimens of rocks, fossils, and other mineral structures, I could not find that there was any machine to be purchased suitable for the purpose; I was therefore led to design an apparatus for myself, which I have had in operation for about twelve months. As will be seen from the diagram (on next page), this machine is in some respects similar to that described by Mr. Butterworth in the January number of Science Gossip. It consists of a wooden framework, *a a*, made of beech-wood, and supporting a crank axle and driving-wheel, two feet diameter; the top-part of this frame consists of two cross-pieces, *a′* fixed about an inch apart, as in the bed of an ordinary

turning-lathe; into the slot between them is placed a casting, B, carrying the bracket for the angle-pulleys, C; this casting is bored to receive the spindle, D, which, by means of the treadle, is made to revolve about 400 or 500 revolutions per minute. It is also



bored to receive another spindle, E, to the top of which is fixed a metal plate, F, for carrying the small cup, H, to which the specimen is attached by means of prepared wax. I find that this means of mechanically applying the work to the slicer is far preferable to holding it in the hand in the ordinary way; the requisite pressure against the cutting disc is regulated by the weight G, and the thickness of the slice by the thumb-screw, K, on which the spindle rests. By this means, I am enabled to cut tolerably thin and parallel slices—the thinness, of course, varying according to the strength of the rock which is being operated upon. The slitting disc is made of soft iron, eight inches diameter, and about $\frac{1}{50}$ of an inch in thickness, and it is fixed on the spindle D, between two brass-plates four inches diameter, in the usual way. The operation

of charging the edge of the disc with diamond powder, requires some little care. Having reduced the diamond to the requisite degree of fineness in a hardened steel mortar (so fine that no sparkling is perceptible on exposure to light), a few grains are placed in a watch-glass, made into a paste with a drop of sweet oil, and applied to the edge of the disc with a quill; while the disc is being slowly revolved by hand, it must be gently pressed in with a small roller of glass, or hard steel, until the particles of diamond powder are securely bedded in the edge of the metal, care being taken to avoid getting any of it on the sides of the slicer. In cutting, it is necessary to steady the work with the hand, and not to trust for pressure entirely to the suspended weight. The work must be constantly lubricated with brick oil, but spirits of turpentine will, I believe, answer the same purpose. I may mention that when we can obtain a sufficiently thin piece of the specimen by a dexterous chip with the hammer, or other means, the operation of slitting may, of course, be dispensed with.

Having prepared suitable slices of about $\frac{1}{16}$ or $\frac{1}{8}$ of an inch in thickness, it is necessary to reduce them still further by grinding with fine emery and water on a lead "lap," which is made to revolve on the spindle (*D*). This lap is eight inches diameter, and about $\frac{3}{8}$ of an inch thick in the centre, cast with rounded edges, and slightly convex sides. I find that this form facilitates the grinding of a uniform thinness, there being always a tendency on a flat surface (which soon wears hollow) for the edges of the section to grind away before it is sufficiently thin. One side of the section can easily be ground and finished by holding in the hand, and this being done, it must be cemented with hard Canada balsam to a small square of plate glass, in order to grind the other side, which operation must be carefully carried on until the structure appears distinct and well defined. Mr. Sorby tells me that he grinds his sections on the glass slides on which they are intended to remain, thereby obviating a second mounting—the corners of the glass, in this case, must be protected with small pieces of zinc during the operation of grinding. This plan requires very careful manipulation. When sections thus prepared are to be mounted in balsam, under a glass cover, I have never found it necessary to polish them; the only finish requisite is best given by careful rubbing on a flat surface of Water-of-Ayr stone (without polishing powder of any kind)

until all traces of the lines of grinding and scratches are removed.

Having thus obtained a perfect section on the plate glass, it is easily removed, by gently heating over a spirit lamp, and should be placed in spirits of turpentine for an hour or two to dissolve off all superfluous balsam. In order to ensure a perfectly clean section it is well to boil it in fresh turpentine before mounting.

Thin sections of rocks are usually mounted in Canada balsam under a glass cover in the ordinary way.

On the reading of this paper a series of specimens was exhibited, shewing the various stages in the operation of preparing rock sections for Microscopical Examination.

Some further remarks upon the Fly's Proboscis.

By B. T. Lowne, M.R.C.S. Eng., &c.

(*Read April 23rd*, 1869).

The necessity for making some further remarks upon the Proboscis of the Blow-Fly occurred to me for two reasons: first, because I described certain structures in my former paper under names, and attributed functions to them, which were the result of too slight an investigation of this difficult piece of anatomy; and secondly, because I have discovered several most important structures since I made that communication.

The *fulcrum*, described in my former paper, is a far more important organ than appeared at first sight, being in point of fact the sucking pump of the proboscis: its walls are double, and these are kept in close apposition by their elasticity, but are capable of being drawn asunder by the action of the muscles which fill the hollow of the organ, opening a cavity between them which is continuous above with the œsophagus, and below with the mouth of the insect. The opening of this cavity draws the fluid from the mouth and sucker of the proboscis, and its closure, which is effected by its own elasticity, forces the fluid with which it becomes filled into the œsophagus and stomach. The necessity for valves is obviated by the peculiar manner in which the muscles of this organ act, the lower fibres contracting and relaxing before the upper ones, so that a wave-like motion is given to the anterior wall of the cavity.

The terminal joint of the proboscis encloses the ligula—a thin pointed chitinous piece, extremely delicate at its free extremity, and covered with fine setæ; the upper portion of this piece is united closely with the labium, and the salivary duct opens upon its anterior surface. The epiglottis, with its lateral appendages, has already been described by me as being tubular above, and enclosing the œsophagus; but if that tube be considered to cease at the superior extremity of the fulcrum, where its walls become corneous, some modification of these terms will be advisable; the fulcrum may be considered analogous to the pharynx, and either term appears to me equally applicable; the epiglottis, which is really a

synonym for the labrum or upper lip, will more appropriately receive that name, and the mouth of the insect will be understood to commence at its superior extremity.

The lower three-fourths of the conjoined pieces forming the upper lip is open behind—that is towards the labium and ligula, which it protects; it is only attached to the proboscis at its upper extremity, but is firmly fixed in its place in a kind of groove, formed by the overlapping of the membraneous portion of the integument on either side of its whole length; it can be caused, however, to start from its place by a little violence, without any rupture of membrane, so that it projects forward and exposes the cavity of the mouth. This piece is lined with epithelial cells filled with orange coloured pigment.

The salivary duct is an elastic tube, which originates in a sacculus on either side of the thorax: this sacculus is extremely transparent, lined with pavement epithelium, and surrounded by convolutions of the salivary gland, which opens into its inferior extremity near the middle of the thorax. The gland itself is a very long convoluted tube, which closely surrounds the sacculus, above described, with numerous convolutions; it continues, however, below the sacculus in fewer convolutions, until, at the opening between the thorax and abdomen, it becomes straight and passes through that opening, bound closely to the œsophagus, and then, passing backwards over the pulmonary sacs, dips down below the Malpighian vessels, and terminates in a blind extremity near the anus.

This peculiar course of the salivary gland, together with the close approximation of the lateral tracheæ to the sacculus of the gland, and the resemblance of the structure of the duct itself to that of a tracheal tube, misled me, and induced me to describe the relations and functions of these parts erroneously. I had not then found the true termination of the salivary glands in cœcal extremities, but had lost them several times, where they are closely bound to the œsophagus, and where they may easily be made to appear to open into it.

Just above the labium the salivary duct changes its character and dilates into a cavity somewhat resembling the human glottis: this is a most perfect valve, for its anterior wall is elastic and pressed back at its inferior portion against the posterior wall, so entirely closing the duct at this point. A pair of long slender muscles, arising at the superior extremity of the fulcrum, run down

the back of that organ, and are inserted into the lower part of this valve, opening it by their contraction.

The purpose of this valve will be evident when the whole of the functions of the proboscis are considered. The united lips, as we have already seen, form a sucker, communicating with the cavity of the mouth, either directly through the triangular opening which supports the teeth, or indirectly through the false tracheæ of the lips. I believe now that this sucker is exhausted, simply by the muscular act of the fly's pulling against the central portion of the disc, where the lips are united to the rest of the proboscis ; just as a leather sucker is exhausted by pulling the central string. The purpose of the false tracheæ is, undoubtedly, that of a most effective strainer. The fly usually feeds on half rotten substances, in a soft pulpy state; if such matter were drawn directly into the cavity of the sucker, and from thence forced or sucked into the tubular mouth and pharynx of the insect, it would immediately fill that cavity and completely stop it up; the fine openings in the false tracheæ strain out the fluid portions of the food, and so permit the insect to feed on such soft pulpy substances as decaying fruit, &c. It is easy to fill the false tracheæ with blood by allowing the insect to suck it; my former failure with coloured syrup may be attributed to the fact that this substance was perfectly free from solid particles, and hence was easily taken into the mouth through the triangular opening; whilst the blood supplied might and probably would always contain threads of fibrine, which the insect requires to dissolve by the action of its saliva before admitting them into the cavity of its mouth.

It will be easily understood that the sucker-like action of the lips, as well as the opening of the pharyngeal cavity, would tend to exhaust the mouth of air, and so to cause a flow of salivary fluid into its cavity, which would continue as long as the proboscis was in action, were it not for the valvular arrangement in the salivary duct.

The opening and shutting of the valve is controlled by a ganglion placed just below it, behind the duct; nerves from this ganglion are distributed to the mouth, as well as to the long muscles which act upon the valve; any dryness of the epithelial lining of the mouth, in which these nerves ramify, would undoubtedly communicate an impression, and cause a reflex act by which the valve muscles contract, and so cause a flow of saliva by opening the valve.

The air, which escapes from the opening between the lips, noticed by

Gleichen and myself, is probably from the stomach, which often contains a considerable quantity, forced into it, it appears, by the pharyngeal apparatus I have described.

Two pair of cephalic nerves are distributed to the proboscis; a large pair arise from the underside of the cephalic ganglion, and supply the lips and palpi, giving branches to the various muscles of the organ; a smaller pair arise higher up near that part of the cephalic ganglion, which is perforated by the œsophagus. These seem to correspond to the ordinary spinal bridles of insects, and terminate in the ganglion at the back of the salivary duct. Near the superior part of the pharynx they each send off a branch which communicates with a small ganglion beneath the œsophagus, from which filaments to the œsophagus and to the muscles of the pharynx are given off.

Dr. Braithwaite and Mr. Suffolk expressed their gratification with the character of Mr. Lowne's paper, and their assent with the conclusions therein arrived at; and Mr. Suffolk pointed out the paucity of published works on the subject, there being only four existing. The Quekett Club had brought some of the workers together, who would not otherwise have been known to each other, and some of whose labours might not otherwise have been recorded.

The President asked Mr. Lowne why he called the organ of which he had been speaking a salivary gland? Saliva served two purposes; it softened the solid parts of the food during mastication, but the blow fly did not masticate its food. Saliva also effected a chemical change in the food by converting starch into sugar, but the blow fly does not feed upon substances which require to be so acted upon.

Mr. Lowne said that he had simply followed the words of Cuvier. Although the fly does not masticate, yet it grinds the food, and the fluid of which he had spoken answers the purpose of saliva by helping to soften the hard substances on which it feeds. It might be wiser to employ a different set of terms to designate the organs of insects from those which are used in reference to animals, but in so doing we should complicate nomenclature very much. Further, as we know that this fluid is a secretion, that it is carried into the alimentary canal, and that it serves to soften the food, he thought he could not be far wrong in regarding it as a saliva.

On a Secretion from the Stomach of the Flamingo.

By B. T. Lowne, M.R.C.S., &c.

(Read May 28th, 1869.)

Some time ago my attention was drawn to this subject by a paragraph in the *Field* newspaper, from the pen of my friend Mr. Bartlett, of the Zoological Gardens, and that gentleman kindly gave me the slide I have brought for your inspection this evening, with most of the information I possess upon the subject.

The secretion in question when examined microscopically, is found to consist of numerous oval blood corpuscles, together with some beautiful arborescent crystals, probably chiefly chloride of sodium. The following is the history of this slide, related as nearly as possible in Mr. Bartlett's own words.

The Flamingoes in the Zoological Gardens have frequently shown signs of breeding, but although they have been supplied with sand for their nests, they have never done so; they have, however, taken considerable notice of a pair of Cariamas which are kept in the same aviary, and seem to have mistaken these birds for their own young. The Cariamas have a peculiar habit of bending back their heads, opening their mouths, and at the same time uttering a plaintive sound somewhat resembling that of young birds; this attracts the Flamingoes' attention, and Mr. Bartlett has often has often seen them stand over the Cariamas and making a slight undulatory movement of the head and neck, pour a reddish fluid from their mouths into the beaks, and as frequently over the backs, of their *portegés*: it is a small quantity of this fluid which I have placed before you.

My friend—and I know no more able, practical naturalist—believes that this secretion, which he describes as a clear, red-coloured, glutinous fluid, is the natural means with which the Flamingo is endowed for feeding its young; he thinks other food may be supplied as well, but that this is an additional means of nourishment.

Many birds are endowed with a power of secretion in the crop for special purposes. Sometimes the secretion is mixed with other

food for feeding their offspring; the pigeon affords a well-known example: when the young are about to be hatched, the lining membrane of the crop becomes thickened and pours out a milky fluid, which, mixed with comminuted grain, is given to the young. An even more remarkable example is afforded by the Hornbill, for a detailed account of which I am likewise indebted to Mr. Bartlett: the male bird, when the female is sitting, is addicted to rather an Eastern mode of procedure; he builds up his mate in the hollow of the tree where her nest is built, with a mud wall, leaving a hole through which he feeds her, keeping her a close prisoner until the young are grown. This extraordinary bird fills his crop with fruit, and after a time, brings the whole up, surrounded by a gelatinous envelope, secreted by the walls of the crop—this he presents to his captive wife, a cabob of peculiar composition.

It is a matter of paramount importance for future observers to settle, whether the blood with which the secretion from the flamingo's stomach is stained is a healthy or unhealthy element in it. Several of the swifts and swallows are provided with a secretion from the crop, with which they agglutinate the materials for their nests. It is well known that the swallows which make the edible nest of which the Chinese make their soup, elaborate that delicacy in their crops. It is, moreover, asserted that when deprived of their first nest the second is often stained with blood. This may be accounted for by the crop becoming highly congested by the efforts of the bird to construct a second nest. The case of the flamingoes may be analogous to this. We know they are placed under unnatural conditions, and during sexual excitement which does not lead to the development of ova nothing is more likely than an over congested condition of the crop.

The formation of a blood-stained secretion is of importance in another point of view, especially if this should turn out to be a healthy act, which Mr. Bartlett thoroughly believes, as he thinks it explains the old fable of the pelican feeding its young with its own blood, supposing the flamingo to be meant instead of the pelican. This secretion appears to afford an additional argument in favour of a theory first propounded I believe by Bichat, that in certain hæmorrhages the blood escapes from the capillaries without any rupture of their walls, by a process which has been called exhalation. I remember a very eminent professor of medicine stating his belief in the process, and explaining the manner in

which the corpuscles might pass through the capillary walls by an alteration in their form.

Even if the process in the flamingo is an unhealthy one, it may still afford some evidence on this interesting point. In that case it may be considered analogous to the excretions of blood-stained sweat from the skin. Although cases of this kind are rare, yet they are well authenticated in man.

Mr. Bartlett assures me that the hippopotami in the Zoological Gardens frequently exude blood-stained sweat when furious, and the same gentleman told me a very curious and interesting story about a pair of rhinoceri which Mr. Jamrack, the celebrated dealer in beasts, once bought, I think at Calcutta. It appears that the poor animals suddenly conceived a desire to see their native forests once more. They both escaped and rushed wildly away from their keepers, who did not overtake them for a long time—something like twelve hours, I believe—and when they did they found their hides covered with blood, which did not issue from any wound, but from the whole surface. A few hours after both died.

On the Imaginal Discs of Dr. August Weismann.

By B. T. Lowne, M.R.C.S., &c.

(*Read May 28th*, 1869.)

The development of the fly has been the subject of a most elaborate paper by Dr. Weismann, written in 1866 (Kölliker and Siebold Zeitschrift, band. 14). Although the observations of this learned naturalist have long been known in Germany, they seem to have attracted little attention in this country, and some incredulity. The specimen I have brought with me to-night shows the structures from which the head and thorax of the perfect insect is formed, attached to the main nerves, near their origins from the brain of the maggot, which they closely surround.

The substance of Dr. Weismann's paper is that the head and thorax of the fly, with the wings and legs, are developed from a number of discs (Imaginal-Scheiben) attached to the main nerves and tracheæ of the maggot, which do not coalesce until the third day of the pupa state. The abdomen is developed from cells immediately dependent for their formation upon the eight posterior larval segments. Dr. Weismann states his belief that in all those insects in which the anterior larval segments bear legs, the head and thorax also depend for their formation upon the corresponding larval segments; but in those in which these appendages are absent in the larva, the head and thorax of the perfect insect is entirely dependent for its form and development upon imaginal discs, like those in the larva of the fly. Another most remarkable fact in the development of the fly from the larva, is that all the larval organs undergo degeneration, and that not one of these remain in the perfect fly. Extraordinary and incredible as these observations appear, I am happy to be able to state that I have entirely verified them, and trust that no great time will elapse before I place the result of my observations before the scientific world. In the meantime I cannot but express my entire concurrence in Dr. Weismann's views.

REVIEW.

A History of the British Hydroid Zoophytes. By Thomas Hincks, B.A. In two vols., 8vo. London: Van Voorst.

Reviewing is not our province, but we cannot refrain from noticing a work which has long been wanted, and which so well fills up the gap which has hitherto existed in zoological, and we may add, in microscopical literature. Since the appearance of the last standard work on Zoophytes—Johnston's well-known "History"—twenty-one years ago, some sixty memoirs on the Hydroida have appeared, trebling the number of species, and rendering it a task of no small difficulty to identify any of the rarer species of our Hydroid Cœlenterates.

Although Mr. Hincks' splendid monograph is chiefly devoted to the description of genera and species, yet his account of the anatomy and physiology of the Hydroida as a group, will, we think, be found the most interesting portion of the work, for it is here we find, in greatest perfection, that clear and logical expression and simplicity of style, which can only spring from a complete mastery of the subject, and which renders such works as these interesting alike to the general reader and to the advanced scientific student.

The first volume contains the text; the second, the plates, of which there are sixty-seven, lithographed by Mr. Tuffen West, after drawings by the author, mostly original. With a few exceptions, each species is drawn natural size, and with a portion enlarged to an uniform scale, about twenty diameters, more highly magnified figures being also given where necessary.

In the volume of text, a general introduction to the study of the Hydroida is prefixed to the description of genera and species.

The terminology which the author adopts is first explained. As few special terms are used as are consistent with scientific accuracy, and these are employed in the sense in which they are generally received, with one or two unimportant exceptions. The term Gonophore, for instance, as here employed, means the whole reproductive bud, and "the sexual zooid developed in it, whether as a

fixed sac or a floating polypite, is the gonozooid." The Gonotheca, or chitinous capsule "within which the gonophores are produced," is of course a distinct structure.

The Hydroid colony is then described, and here we find the anatomy and physiology of the minute appendages fully explained. The thread cells, with their retractile poisonous darts; the palpocils or sensitive hairs; the nematophores, with their curious processes; the extensile filaments or fishing lines; and the extraordinary snake-like organs of the genus *Ophoides*, are especially interesting to the microscopist; and here he will find a concise account of their minute anatomy, supposed functions, and observed actions.

The following graphic description of the circulation is given in this section:—

> "A stream, bearing along with it a multitude of restless granules of various sizes, issues from the stomachs of the polypites and rushes through the cavity of the cœnosarc, pervading every portion of the organism. After flowing downward for some time, there is a pause in the circulation, and then the current rushes back with great impetuosity, and once more entering the stomachs of the polypites, mingles with the contents. A busy ferment takes place for some seconds in the digestive sac, the larger particles hurrying to and fro amidst the contained mass of food, until at length the efflux again commences. The inner surface of the cœnosarc is covered with vibratile cilia, and these seem to be the chief agents in maintaining the flow of the currents."

The section headed "Reproduction" is a most absorbing portion of the work, and here again we find a full account of the microscopic organs.

In his description of the medusiform zooid or swimming polypite, the author is quite enthusiastic. After minutely describing its structure and functions, he says:—

> "It would be difficult to exaggerate in speaking of these floating flower buds, as they may well be called. The vivid tints which they often display, the gracefulness of their form, the exquisite delicacy of their tissues, and the vivacity of their movements, combine to render them singularly attractive. Frequently they are so translucent that their bubble like forms only become visible in a strong light. In other cases the umbrella is delicately tinted, while the manubrium displays the gayest colours, and brilliant ocelli glitter on the bulbous bases of the tentacles. To their other charms that of phosphorescence is often added; they are not only painted like the flower, but at night they are jewelled with vivid points of light, set round the margin of the bell, or one central lamp illumines the little crystal globe, and marks out its course through the water. . . . . . Like miniature balloons they float suspended in the water for awhile: then they suddenly start into motion, propelling themselves by a series of vigorous jerks or casts, and at the same time contracting the tentacles into the smallest compass; then they become quiescent again, and sink slowly and gracefully, like parachutes, to the bottom of the vessel, some of the arms extended laterally, and the rest dependant. In all cases locomotion is effected by the pulsation (alternate systole and diastole) of the swimming-bell."

The rate of growth, phosphorescence, and geographical distribution of the group are then noticed, and the best method of collecting the different forms is pointed out. In searching for the minuter forms, the naturalist is recommended to select a likely pool, and to lie down on the rocks beside it, peering into it patiently and intensely, and never forgetting to look for the shadows, "for in following them he will often secure the reality." The overhanging seaweed must also be lifted up, for under it grow many of the minute species.

Dichotomous tables, which greatly facilitate the identification of species, follow; and lastly the scheme of classification adopted is fully explained.

The class *Hydrozoa* is divided into three orders—*Hydroida*, *Syphonophora*, and *Discophora*. The order *Hydroida* being further divided into the sub-orders *Athecata*, *Thecaphora*, and *Gymnochroa*. The first and second of these have a polypary—the third, containing the single genus *Hydra*, is entirely without. The *Athecata* (*Corynidæ* of Huxley and *Tubularina* of Johnston) have no true calycles or capsules; while the alimentary and reproductive zooids of the *Thecaphora* (*Sertularidæ* of Huxley) are invariably protected by true calycles and capsules. The *Gymnochroa* (*Hydridæ*) again, are free, while the others are always ultimately fixed. Now, the natural alliance of the order stands thus:—*Gymnochroa*, *Athecata*, *Thecaphora*. Why, we should like to know, does the author destroy this natural sequence by placing the *Gymnochroa* last? The sub-orders are further divided into twenty-two families, and these again into fifty-eight genera, containing about one hundred and sixty species.

We have only noticed the introduction, and of the body of the work, can only say that it is admirably arranged, and shows that the author is equally well acquainted with the literature of his subject, as with the living forms which he so graphically describes.

A list of works on the Hydroida, and an index to the text and illustrative woodcuts, complete the work.

In conclusion, we can recommend this work as a most delightful companion to the sea-side; and we may safely say, as the author says of Johnston's "Zoophytes," that "it will always rank, with the 'Corallines' of Ellis, amongst the classics of natural history literature."

J. H.

NOTES.

On Preparing and Mounting Sections of Hard Tissues.

Some ten years since there appeared in "Silliman's Journal" a note by Dr. Christopher Johnstone, "On Preparing and Mounting Hard Tissues for the Microscope," which describes a method of procedure which is worth the notice of our members We therefore give a summary of its contents.

A microscopic section should be as thin as the structure of the object will allow, of uniform thickness, and polished on both sides, whether it be mounted in the dry way or in balsam. The following requisites should be provided :—

1. A coarse and fine Kansas hone, dressed flat with fine emery.
2. A fine Stubb's dentist's file (or a watchmaker's superfine potence file).
3. A thin dividing file and fine saw.
4. Some Russian isinglass boiled, strained, and mixed with alcohol, sufficient to form a tolerably thick jelly when cold.
5. Canada balsam.
6. Glass slides.
7. Thin glass for covering.
8. One ounce of chloroform.
9. One ounce of strong aqua ammonia.
10. Some pieces of thick plate glass, one inch square, or one by two inches.
11. Thin French letter paper, of which 500 or more leaves are required to fill up the space of an inch.

Coarse sections may be obtained with the saw or dividing file (excepting silicified substances), but these instruments are not applicable to longitudinal sections of small human or other teeth, small bones, &c. These should be first ground upon the coarse hone with water, until the surface coincides with the intended plane, then washed carefully, finished upon the finer hone, and then polished upon soft linen, stretched upon a smooth block.

If the object be too small to admit of handling, it should be fastened upon a piece of glass with isinglass, or, what is better, upon thin paper well glued with the same substance upon glass ; and a piece of thick paper or visiting card, perforated with a free aperture for the object, must be attached to the first paper. This is the guard down to which the specimen must be ground with *oil;* and its thickness and the disposal of the object requires the exercise of good judgment. Hot water will release everything, and chloroform (or benzine) remove the grease from the specimen, which, like the former one ground with water, is ready for the second part of the process.

Now cover the surface of a piece of the plate glass with thin French letter paper; next apply a paper guard, as before stated, but not thicker for teeth and bone than 1-500th inch ; then trace a few lines with a lead pencil upon the first paper, in the little space left in the guard, so that the increasing transparency of a specimen in course of preparation may be observed ; and, finally, moisten the space with isinglass to the extent of the object, which must be delicately brushed over on the ground surface and at the edges with tolerably thin isinglass before it is cemented in its place. Gentle pressure must now be applied and maintained by a wire spring or other means.

In two or three hours it will be dry, and the second side may be ground in oil. A file may be used at first, but must not be persevered in, and the operation must be completed on the bare hone. When the second side shall have been wiped with chloroform, it may be polished with a bit of silk upon the finger. After spontaneous separation from the slide and paper in warm water, the specimen should be well washed on both sides in cold water and then allowed to dry. After immersion in chloroform for a moment, and having been examined to ascertain if free from possibly adherent particles, the section is ready for mounting.

A few precautions are necessary with particular sections. Transverse sections especially, should be dried between glass, to avoid warping, and very porous structures should be well saturated with glue and dried before being cut.

In mounting, spread a sufficient quantity of old and thick Canada balsam upon a slide, and when cold place the section upon it. Cover it now with a quantity of equally inspissated balsam, warmed until it flows, and then immediately warm the slide, being careful to employ the least possible heat. Depress the section, and withdraw every air bubble towards the edge of the slide, with a stout needle, set in a handle; put on the cover glass slightly warmed, not flat, but allowing one edge to touch the balsam first, press out superfluous balsam, and the specimen is safe. The slide, when cooled, may be cleaned with a warm knife, spirits of wine and ammonia.

The author of the paper expresses his conviction that neither Canada balsam nor gum mastic will retain the first ground side of a specimen long enough upon the slide to enable the preparer to reduce it to the requisite thinness, and with both these substances heat must be employed, which is objectionable, because most objects are thereby warped and cracked, and furthermore the paper guard is indispensable for limiting and equalising the thinness of a section.

The writer has tried this method with very considerable success.—*Ed.*

Marine Dredging.

A week or two since, five or six members of the Q.M.C. were invited by Mr. Marshall Hall to visit him on board his yacht, "The Norma," for the purpose of obtaining a day or two's dredging at the mouth of the Thames. The party joined at Southend, off the pier of which town the yacht was found at anchor. The hospitable owner had already a new dredge on board, and another one, which was not new, was taken down by one of the visitors. The first attempt made with the new dredge proved a failure, as did every trial made with it during the day. The old one was then hove overboard, and soon yielded a large number of specimens. As the trial was merely considered an experimental one, no note of species was made, but several were preserved alive for some days, and exhibited at the next meeting of the Club, and also at the College of Physicians; and we have, at the moment of writing, several living specimens of *Noctiluca miliaris*, which were obtained on the second day by means of a muslin net.

Our chief object in recording the excursion, is to point out the rich harvest of beautiful living organisms, which can be obtained at a comparatively small cost by means of the dredge. Many, or indeed, most of the specimens obtained, have only been seen alive by professional naturalists, and but little is known of their life history. Facts are required, and these facts can only be obtained by the observations of a number of persons interested in the pursuit. It may

be noticed, too, that the specimens obtained on the shore at low water are not in so great perfection as those which are obtained from the sea bottom, while many species are only found below low water mark.

The requisites for dredging are few, the chief thing required being the dredge. We recommend one of small size, such as those used in obtaining whelks, &c., by fishermen. They are small enough to be portable, and yet heavy enough to keep close to the bottom without jumping over it. Buckets filled with water form the best receptacles in the first instance, as the specimens can there be washed, and a selection made for deposition in glass vessels for subsequent examination. Even for carriage we prefer glass, as the material of the jars, as earthenware is porous, difficult to keep clean, and liable to leak after a time. A long line should be provided of the kind known as a deep sea line, and boatmen may easily be found at most places on the coast, who know sufficient of the ground to be traversed for the purpose of guiding the collector. A net of fine muslin, spread over a ring and attached to a stick, will be most useful for obtaining many swimming animals, and especially some of the larval forms, on a calm, sunny day, thus affording abundant material to the microscopist. Now that many of our members are likely to visit the coast, many opportunities will offer themselves for exercising this method of obtaining specimens for study in the way of our favourite pursuit.—*Ed.*

The Fauna of the Victoria Docks.

Mr. Kent, of the British Museum, at one of the excursions of the Quekett Club to the Victoria Docks, discovered a new Nudibranch of the genus *Embletonia*, which he calls *E. Grayii*, also a new Polyzoon, large numbers of a species of Mysis, the respiratory organs of which he has been investigating, and besides these that most interesting fresh-water Hydrozoon, *Cordylophora*. These interesting forms are associated with a vast variety of fresh-water Rotiferæ, Entomostraca, and Infusoria. The occurrence of *Embletonia* in this position is exceedingly interesting. It appears, from some observations of Dr. Gray, that *Embletonia pallida* is found in the Baltic, extending far up into that part of the sea, where the water becomes almost fresh. Hence the occurrence of the genus in the brackish or nearly fresh water of Victoria Docks is not without parallel. It is an important subject for inquiry, as to how the fauna of the Victoria Docks originated. Is it the representative of an ancient marsh fauna, presenting in its Nudibranch and Hydrozoon an indication of the recession of the sea? Or has *Embletonia* been introduced with ships and established itself, and has *Cordylophora*, long since adapted to lacustrine conditions, also been introduced since the time when the area was a marine one?—*Quarterly Journal of Science.*

"The State Microscopical Society of Illinois."

Under this somewhat pretentious title a file of "The Chicago Sunday Times," date May 30th, 1869, devotes six columns, with the heading of "Microscopy" in large capitals, to an account of the first conversazione of the Society, and we are also favoured with its history. It seems that in the early part of last winter "The

Chicago Microscopical Club was formed in connexion with the Chicago Academy of Natural Sciences ;" but evidently taking the cue from another Society at home (which is mentioned by name), it is thought necessary to make the infant Club into a fashionable Society; and accordingly "a bill was immediately prepared and sent to the State Legislature, and a law was passed, incorporating 'The State Microscopical Society of Illinois.'" It is stated that the number of members is 60, and on the occasion of the Soirée 50 microscopes were exhibited." What effect the charter of incorporation may have in stimulating real work we are not yet told, but doubtless we shall see the results in due time.

Type Slides.

We have recently been favoured by Mr. Curties with an examination of another Type Slide sent over by M. Muller, and containing 100 diatoms; these are arranged in straight lines, forming a square of such a size as to be easily included in the field of a $\frac{2}{3}$-object glass, and the price is nearly one-third of that noticed on a former occasion.

QUEKETT MICROSCOPICAL CLUB.

MARCH 19TH, 1869.

ARTHUR E. DURHAM, ESQ., PRESIDENT, IN THE CHAIR.

The minutes of the preceding meeting were read and approved

The following donations were announced :—" Scientific Opinion," from the Publisher; " Science Gossip," from the Publisher; " Land and Water " from the Editor; " On the Caudal Heart of the Eel," from Dr. Wharton Jones; The Copper Plates of Dr. Hooke's " Micrographia," 1745, from Mr. J. J. Fox; "The Monthly Microscopical Journal," from the Publisher; Michael Colombo's " Mikroskopische Beobachlungen von Polypen des Sussen Wassers," and Eichorn's "Beytrage zur natur geschichte der Kleinsten Wasser," from Mr. Jno. Wheldon; some casts of Diatoms from Dr. Maddox; a series of Micro-Photographs, and two bottles of Diatoms, from Professor Arthur Mead Edwards, of New York; two slides of Deep Sea Soundings, from Mr. Hailes; and six slides from Mr. Slade.

Thanks to the donors were voted unanimously.

The following gentlemen were proposed for membership :—Mr Henry Long, Mr. Charles Frederick White, Mr. Vernon Smith, Mr. Delferier, jun., Mr. Thomas H. Collins, Mr. T. G. Smart, Mr. Thomas Jefferson, Dr. Henry Lawson, Mr. Arthur Edwin Quekett, Mr. Alfred J. S. Quekett, Rev. William Quekett.

Thirteen gentlemen proposed at the previous meeting were then ballotted for, and subsequently declared duly elected.

The Rev. E. C. Bolles, President of the Portland (Maine, U.S.A.), Society of Natural History, and M. Alphonse de Brebisson, of Falaise, Normandy, were proposed and duly elected honorary members of the Club.

Among other objects announced for exhibition was Amphipleura pellucida, by Mr. Thomas Powell.

Mr. Suffolk read a paper "On a Method of Drying Microscopic Objects."

The thanks of the meeting were presented to the author of the paper.

A discussion ensued, which mainly turned on the construction of a vessel capable of containing ether, without allowing it to evaporate. Various materials were suggested for the joint, including cork pressed upon an edge, vulcanised rubber, and gold beaters' skin.

Mr. T. F. Wight read a paper " On a Method of Coating Glass Chimneys." The method simply consisted in making a mixture of whiting, or plaster of Paris and water, and coating the inside of the glass chimney, allowing it to dry, and then removing the portion through which the light was required to pass.

Mr. Slade then gave a detailed description of the slides which he had presented to the Cabinet.

The President announced the first field excursion for Saturday, April 3rd, to Hampstead Heath, and also stated that at the next meeting Mr. B T. Lowne woald furnish "Some further remarks on the Proboscis of the Blow Fly."

The meeting terminated in the usual manner.

APRIL 23RD, 1869.

ARTHUR E. DURHAM, ESQ., PRESIDENT, IN THE CHAIR.

The minutes of the preceding meeting were read and approved.

The following donations were announced:—"Science Gossip," from the Publisher; "Land and Water," from the Editor; "The Proceedings of the Bristol Natural History Society," from the Society; "The Proceedings of the Portland (Maine, U. S. A.) Society," from the Society; "Scientific Opinion," from the Publisher, "Monthly Microscopical Journal," from the Publisher; a slide of Brazilian Beetle, mounted between two pieces of thin glass, from Mr. W. H. Golding; four varieties of Crystals of Santonine, from Mr. Hislop; four slides of Diatoms, from Mr Kitton; and 165 slides from Mr. M. C. Cooke.

The thanks of the meeting were presented to the donors.

The following gentlemen were proposed for membership:—Mr. Charles Edward Bean, Mr. Henry W. Lowe, Mr. Walter B. Cole, Mr. Arthur Cottam, F.R.A.S., Mr. Edward Evans, Mr. R Farmer, F.R.M.S., F.G.S., Mr. George Holmes Fryer, Mr. D. Ibbetson, Mr Edmund Albert Letts, Mr. Henry Matthews Dr. John Millar, F.L.S., G.S, R.M.S., Mr. William B. Pepler, Mr. William J. Rowley, Mr Samuel W. Scoble, Professor J. B. Simonds, Mr. Henry G. Sketchley, Mr. F. J. Thirlwall, Mr Henry Walker, Mr. M. Welsh, Mr. Charles Henry Wood.

The President gave notice, on the part of the Committee, that the next meeting of the Club would be made special for the purpose of considering certain alterations in the laws, which were read to the meeting.

A number of specimens were announced for exhibition.

Mr. Lowne then read: "Some further remarks on the Anatomy of the Blow Fly."

A vote of thanks was given to Mr. Lowne.

A discussion ensued. See page 193.

M . Love exhibited and described a new form of turn-table, in which the glass slip was held by checks, so as to make it self-centering.

Mr. Hislop pointed out that the same result might be obtained more simply by placing two pins at opposite sides of the centre of the revolving plate, against each of which the opposite sides of the slip being made to bear, the instrument would be self-centering, without reference to any slight variation of the width of the slip. The screws securing the springs, would answer the same purpose if placed exactly opposite each other, and at the same distance from the centre.

Dr. Braithwaite drew attention to a fine specimen of a moss, *Antitrichia curtipendula*, from the forest of Fontainebleau, which was rarely found in fruit in this country, except at Wistman's Wood on Dartmoor

Mr. Breese exhibited some sections of soft vegetable tissues, made by first saturating the substance with gum before cutting. It then resembled the consistence of cork.

A letter was received from Mr. M. C. Cooke, enclosing one from the Rev. E. C. Bolles, of Portland, U.S.A., returning thanks for his election as an honorary foreign member.

After the usual conversazione the meeting terminated

MAY 28TH, 1869.

ARTHUR E. DURHAM, ESQ., PRESIDENT, IN THE CHAIR.

The meeting having been made special by notice from the committee at the previous meeting, in order to consider certain proposed alterations in the laws, the President called upon the Secretary to read the amendments, with the laws to which they referred, as follows: —

In place of—

II. That the business of the Club be conducted by a President, four Vice-Presdents, a Committee of twelve members (four of whom shall be a quorum), a Treasurer, a Secretary, together with an Honorary Secretary for Foreign Correspondence, who however shall not be *ex officio* a member of the Committee, and the Editor of the Journal for the time being. That two of the retiring Vice-Presidents shall not be eligible for re-election. That the four senior members of the Committee (by election) retire annually, and be not eligible for re-election; but such retiring members may be nominated by the Committee to fill the vacancies occurring otherwise than by regular annual retirement. Such retiring members are also eligible for nomination by independent members of the Club, in accordance with the third paragraph of Rule III.

"*That the business of the Club be conducted by the President, four Vice-Presidents, the Treasurer, the Honorary Secretary, the Honorary Secretary for Foreign Correspondence, and a Committee of twelve other Members, (six to form a quorum). That the Editor of the Journal be ex officio an additional Member of the Committee. That the President, Vice-Presidents, Treasurer, and two Secretaries, with the four senior Members of the Committee (by election) retire annually, but be eligible for re-election*"

In place of—

III. That the Officers and four members of the Committee shall be elected at the Annual Meeting in July. That the Committee shall prepare a list of names of gentlemen to be recommended to the Club for election as officers. This list shall be read at the ordinary meeting in June; and any three or more members who may be desirous of nominating any other member or members for election to any office shall have power to do so, provided such nomination be delivered to the Secretary duly signed, before the close of the meeting; and the name or names of any member or members so proposed shall be printed on the balloting papers, below the names proposed by the Committee.

"*That at the Ordinary Meeting in June, Nominations be made of Candidates to fill the offices of Vice-Presidents and vacancies on the Committee. That such nominations be made by resolutions duly moved and seconded, no Member being entitled to propose more than one Candidate. That in the event of such nominations exceeding one half more than the number of vacant offices, the Candidates be reduced by show of hands to such proportion. That the President, Treasurer, Honorary Secretary, and Honorary Secretary for Foreign Correspondence be nominated by the Committee. That a list of all nominations made as above, be printed in alphabetical order upon the Ballot Paper. That at the Annual General Meeting in July, all the above Officers be elected by Ballot from the Candidates named in the lists, but any*

Member is at liberty to substitute on his Ballot paper, any other name or names in lieu of those nominated for the offices of President, Treasurer, Honorary Secretary, and Honorary Secretary for Foreign Correspondence."

In place of—

VII. That the Annual Subscription shall be Ten Shillings, payable in advance on the 1st of July, but that any member elected in May or June shall be exempt from subscription until the followiug July of the same year. That no person shall be cousidered as a member entitled to the full privileges of the Club until his subscription shall have been paid; and that any member omitting to pay his subscription six months after the same shall have become due shall, after two applications in writing have been made by the Treasurer, be deemed to have ceased to be connected with the Club.

"*That the Annual Subscription be Ten Shillings, payable in advance on the* 1st *of July, but that any Member elected in May or June be exempt from subscription until the following July. That any Member desirous of compounding for his future subscriptions, may do so at any time by payment of the sum of Ten Pounds; all such sums to be duly invested in such manner as the Committee shall think fit. That no person be entitled to the full privileges of the Club until his subscription shall have been paid: and that any Member omitting to pay his subscription six months after the same shall have become due (two applications in writing having been made by the Treasurer), shall cease to be a Member of the Club.*"

In place of—

VIII. That the Accounts of the Club shall be audited by two members, one to be appointed by the Committee, and one to be elected by the members present at the meeting in June.

"*That the Accounts of the Club be audited by two Members, to be appointed at the ordinary Meeting in June.*"

In place of—

IX. That the Annual General Meeting be held on the fourth Friday in July, at which a General Report of the Committee on the affairs of the Club, and a Balance sheet duly signed by the Auditors, shall be read. The Committee shall haud in a list of the names proposed for election as President, Vice-Presidents, Treasurer, and Secretaries; also the names of the four retiring members of the Committee, and the names of the members recommended to fill their places; and the Chairman having nominated two members, not beiug members of the Committee, to act as Scrutineers, the meeting shall then proceed to ballot. If from any cause these elections, or any of them, cannot take place at this Meetiug, they shall take place at the next ordinary meeting of the Club.

"*That the Annual General Meeting be held on the fourth Friday in July, at which the Report of the Committee on the affairs of the Club, and the Balance Sheet duly signed by the Auditors, shall be read. Printed lists of Members nominated for election as President, Vice-Presidents, Treasurer, Secretaries, and Members of Committee having been distributed, and the Chairman having appointed two or more Members to act as Scrutineers, the Meeting shall then proceed to ballot. If from any cause these elections, or any of them, do not take place at this Meeting, they shall be made at the next ordinary Meeting of the Club.*"

In place of—

X. That at the Ordinary Meetings the following shall be the Order of Business :—

(1.) The Minutes of the last meeting shall be read and proposed for confirmation, and signed by the Chairman

(2.) Donations to the Club since the last meeting shall be announced and exhibited.

(3.) Certificates for new members shall be read.

(4.) Ballots for new members shall be taken.

"*That at the Ordinary Meetings the following business be transacted :—*

The minutes of the last Meeting shall be read and confirmed.

Donations to the Club since the last Meeting announced and exhibited.

Ballots for new Members taken.

Papers read and discussed, and

Certificates for new Members read :

after which the Meeting shall resolve itself into a Conversazione."

In place of—

XI. That every member shall have the privilege of introducing one visitor at the Ordinary Meetings, who shall enter his name, together with the name of the member by whom he is introduced, in a book to be kept for this purpose.

"*That any Member may introduce a Visitor at any Ordinary Meeting, who shall enter his name, with that of the Member by whom he is introduced, in a book to be kept for the purpose.*"

Each amendment having been separately put from the chair and declared carried, the business of the special meeting terminated.

The minutes of the last ordinary meeting were read and approved.

The following donations were announced :—"Scientific Opinion," from the Publisher ; "Science Gossip," from the Publisher ; "Land and Water," from the Editor ; "The Monthly Microscopical Journal," from the Publisher ; "Regulations of the Biological and Microscopical Department of the Academy of Natural Sciences of Philadelphia," from Mr. M. C. Cooke ; two slides from Mr. Curties ; six slides from Mr. Quick ; a simplified live box (as described in "Science Gossip," p. 66, March, 1867, and p. 115, May, 1869), from J. W. Meacher.

Thanks were presented to the donors.

Twenty gentlemen proposed at the last meeting were then balloted for, and subsequently declared duly elected.

The following gentlemen were proposed as members :—Mr. Charles J. Beale, Mr. W. F. Burgess, Mr. W. Houghton, Mr. Henry Humphreys, B.A., Mr. Charles E. Layton, Mr. Benjamin Lemmon, Mr. John Samuel Linford, Mr. Horatio Pass, Mr. Lewis Pocock, jun., Mr. Llewellyn Powell, M.R.C.S., and Mr. John Henry Roberts, F.R.M.S.

The President announced the following, among other objects for exhibition. A living polype on a fragment of whelk shell, obtained off Southend (probably *Podocoryne areolata*), shown by Mr. Allbon ; *Noctiluca miliaris*, alive, also from Southend, shown by Mr. W. W. Reeves ; Distoma and other Entozoa from the lung of a Frog, by Mr. J. Slade ; some remarkable Crystals of Sulphate of Zinc, and also of Asparagine, and a very fine injected section of Human Brain,

by Mr. Hislop. A secretion from the stomach of the Flamingo, by Mr. Lowne; Lophopus, Tubicolaria, Stephanoceros, and Melicerta, by Mr. Fitch; Batracho spermum, Volvox, and Closteria, by Mr. Golding.

Mr. Moginie exhibited a new funnel and strainer combined capable of being screwed on the necks of the glass screw topped bottles, for the purpose of collecting aquatic organisms.

Mr. Lowne read a paper "On a Secretion from the Stomach of the Flamingo."

Mr. Lowne also made a short communication "On the Imaginal Discs of Dr. August Weismann."

A vote of thanks was presented to Mr. Lowne for his communication.

Mr. W. W. Reeves called attention to the living specimens exhibited, which were obtained from Southend during a dredging excursion of a party of the members, invited by Mr. Marshall Hall (see Notes, page 202).

Mr. Hislop called attention to a very fine injected section of the Human Brain, by Dr. Dempsey, exhibited by him.

The President announced the excursions and meetings for the month, and also the Excursionists' Dinner on June 23rd, at Leatherhead.

The proceedings terminated as usual.

PROCEEDINGS AT MR. SUFFOLK'S CLASS.

Thursday, January 7th, 1869.

The lecturer, after briefly explaining the Laws of Refraction and Reflection, proceeded to demonstrate the properties of lenses and their application to the construction of various optical instruments, such as the Camera Obscura, Telescope, and more especially the Microscope. The employment of single lenses as microscopes was explained, and some useful hints respecting the use of the hand magnifier given The combination of lenses in the compound instrument was illustrated, and Chromatic and Spherical Aberrations explained. The Binocular instruments of Messrs. Wenham and Powell and Lealand, were mentioned, and the advantages to be derived from their use strongly urged.

The subject of Lamps next engaged the attention of the lecturer, and the respective merits of Gas, Oil, Paraffine, and Camphine were fully discussed, and attention was directed to various lamps supplied by Mr. Collins. After a few remarks on the care of the instrument, and cleaning the lenses, &c., the members of the class were required to examine air bubbles and oil globules, and note their various appearances; they were then exercised in the examination of a few simple substances by reflected light.

Thursday, January 22nd, 1869.

This lecture was devoted exclusively to certain mechanical processes in connection with microscopical operations, such as cutting glass with the diamond, drilling holes in glass, the use of corundum grinding tools, the mode of cleaning slides and thin glass, and bending and drawing glass tubes. Cementing with marine glue, the manufacture of cells and troughs, and the bending, tempering, and otherwise utilizing needles and other small pieces of steel were also explained.

The objects examined were—Sole Skin, Feathers of Peacock and Humming Bird, with especial reference to the importance of the direction of the illuminating pencils. Bread crumbs were also examined in various ways, as recommended for a preliminary lesson by Dr. Beale.

Thursday, February 4th, 1869.

The processes of Dry Mounting in various ways were explained and illustrated practically by the lecturer, modes of drying tissues were mentioned, and a new process at present being experimented upon with a view to its adaptation to microscopical purposes described The nature and properties of Canada Balsam, and its uses as a mounting medium, were treated upon at length. The objects suitable for treatment with balsam, and the preparation required before mounting, were described. After stating the various advantages to be derived from the use of this medium, and also its defects and its use as a cement, espe-

cially in cutting sections of hard substances, a lesson on mounting in balsam was given by the lecturer and his assistants, and several slides were prepared by each member of the class; some Sifted Sponge Sand, and Splinters, and Lucifer Matches were then examined, and their respective structure explained.

Thursday, February 18th, 1869.

The subject of Fluid Mounting was commenced, the lecturer's remarks being principally confined to the manipulative portion of the subject. After the process of closing the cell with objects in fluid had been practised by the members of the class, a number of objects mounted in various fluids were exhibited in the various microscopes.

Thursday, March 4th, 1869.

The subject of the last lecture was continued, with especial reference to the fluid media used in the preservation of objects; their various merits were discussed, and formulæ given for making the principal media. The preparations made by the class since the last lecture were examined by the lecturer, and their defects pointed out, and hints given for their prevention.

Thursday, March 18th, 1869.

This lecture was entirely occupied by the description of various pieces of apparatus for illumination, and was fully illustrated with suitable objects shown in various ways.

Thursday, April 1st, 1869.

Polarisation of Light, with especial reference to its application to microscopical purposes, formed the subject of this lecture. The phenomena of interference and the changes undergone by a ray of light in its passage through the polarising apparatus, were explained; the respective merits of various polarising and analysing media were discussed, and apparatus illustrating the subject was exhibited.

Thursday, April 15th, 1869.

The processes and instruments used in Microscopic Drawing were described, and opportunities afforded to the members of the class of testing for themselves their respective merits. Various micrometers were explained and exhibited. The uses and capabilities of various drawing materials were discussed, and a brief explanation given of the modes of reproducing drawings by wood and steel and copper-plate engraving, lithography and graphotype.

A verbatim report of these lectures, illustrated with wood-cuts and revised by ths author, is expected to appear in the *Chemical News* about the end of June

The lecturer was assisted by Mr. F. W. Gay, Mr. W. W. Reeves, and Mr. F. W. Andrew, who brought their microscopes for demonstration. Mr. Crouch exhibited his new Pseudoscopic Binocular; Mr. Collins supplied microscopes for exhibition, and the Bockett Lamp for the use of the class, besides other apparatus.

MICROSCOPIC FUNGI.

A SHORT course of demonstrations on Microscopic Fungi, by Mr. M. C. Cooke, are just concluded. They were delivered on alternate Tuesday evenings to a class of about twenty members of the Club. The first lecture commenced with a brief History of the Study of Microscopic Fungi in Britain, and the publications on the subject; this was followed by a description of what constitutes a fungus and the principal features which distinguish these from the other inferior cryptogams. The system of classification adopted for these organisms, was next discussed, and the structure of the larger fungi explained. The two orders which were illustrated in this lecture were the *Hymenomycetes*, of which the common mushroom was taken as the type, and the *Gasteromycetes*, of which the common Puff Ball was the type. The microscopic characters were those to which attention was principally directed, and it was shown that the latter order contained a large number of very interesting minute species, especially the spiral threads of *Trichia*, the reticulated skeletons of *Stemonitis*, the banded or warted threads of *Arcyria*, and the goblet-shaped perithecia of *Craterium*.

The second lecture was devoted almost wholly to that section of the dust-like fungi (*Coniomycetes*) which are found as parasites upon living plants, such as the Cluster cups (*Æcidium*), Rusts (*Trichobasis*), Brands and mildew of the genera *Pregma*, *Puccinia*, and *Triphragmium*, the Bunt (*Tilletia*), and Smuts (*Ustilago*). We have already published the remarks on Bunt spores, which were communicated about the same time, at one of the ordinary meetings of the Club. The dimorphism and trimorphism which prevails in this group was fully and clearly explained. The best modes of collecting, preserving, and mounting the various species were commented upon, and the lecture concluded with an enumeration of the principal characters employed in the classification of the group, and the features whereby the members of one genus are to be distinguished from those of another.

The third demonstration was confined to that section of the *Hyphomycetes*, which are usually called the "White Moulds," or Mucedines. The structure of the Potato mould, and its modes of increase were detailed at length, to serve as a type of the important genus *Peronospora*, so injurious to many kinds of cultivated plants. Numerous examples were adduced of the beauty of form in many of the little plants of this group, which were admirably illustrated by a large series of well-executed diagrams. In fact all the lectures were profusely illustrated by at least one hundred diagrams altogether, which were prepared specially to illustrate this course. This lecture concluded with the blue moulds found upon paste, cheese, and other substances, and a comparison of the structure of the *Mucedines* with the *Mucors* belonging to another order, and which in some cases at least, are a higher development of the Mucedines.

The fourth lecture was occupied principally with the remainder of the *Hyphomycetes*, and chiefly those that are termed "Black Moulds," which occur in velvety patches on the dead stems of herbaceous plants, on twigs, and on rotten wood. The rather extensive genus *Helminthosporium* was recommended as offering a variety of forms in this group, and as having many common species. The form of the fruit in a number of these moulds was compared with the fruit of some of the *Coniomycetes* and *Sphæriacei*.

The last two lectures were devoted to the Ascigerous fungi; the fifth to those of the Peziza kind, or the *Discomycetes*; and the sixth to the *Sphœriacei*. In the fifth lecture the general structure of Ascigerous fungi was familiarly explained, and illustrations given from the genera *Peziza* and *Ascobolus*. The curious blights or mildews belonging to what is termed the *Perisporiacei* terminated this lecture. The maple blight, the hop mildew, the berberry blight, &c., were described, and all the species were specially recommended as interesting and attractive objects for the microscope, with their dark colored globose perithecia seated upon delicate interwoven white threads, and bearing numerous thread-like appendages of very variable form, according to the genera and species to which they belong.

The last lecture was devoted to a casual review of the great number of forms associated together under the term *Sphœriacei*. The lecturer confessed that it was impossible during the time at his disposal to do more than indicate the structure which prevails in the simple and compound *Sphœriæ* and the distinguishing features of the most important groups. The common *Sphœria herbarum*, found in herbaceous plants, was taken as a type of the simple *Sphœria*, and the compound were illustrated by a species of *Valsa*. Allusion was also made to the fungi possessing the habit of Sphœria, but with spores attached to threads and not contained in asci in the interior of the perithecia. These were formerly included amongst the *Coniomycetes*, but now admitted to be conditions of Sphœriaceous fungi. For examples the lecturer alluded to *Aposphœria acuta*, to certain species of *Hendersonia*, *Melanconium*, and *Nemaspora*. Interest was maintained throughout this brief course, which was in all respects eminently successful, the only regret expressed being that it was too short, and a hope that the lectures might be resumed at an early period.

The Annual Soirée.—We are informed that Mr. Jas. Smith, Junr., and Messrs. Murray and Head were among the opticians who exhibited instruments and apparatus at the Soirée on March 12th.

THE JOURNAL

OF THE

Quekett Microscopical Club.

On the Ratio-Micro-Polariscope.

By James John Field, F.C.S.

(Read July 23rd.)

Perhaps no agent has ever been placed in the hands of man more subtle in its powers of analysis than that known in physics as polarized light; since it penetrates not only into the arcana of matter itself, but into those of the mutually opposing forces which are constantly operating between its molecules. Chemistry, indeed, informs us in some measure as to the *nature* of what we term matter; and the energy and intensity exhibited in its actions indicate the potency of those invisible spirits that are ever battling between the elements; *one* aspiring to bind them with the chain of combination; the *other* ever striving to rupture that chain and sunder the atoms; each, in its turn, taking instant advantage of any weakness in its opponent; and thus leading to that incessant molecular activity, which is the key-stone to the whole fabric of this and other worlds' beauties, and marvels.

But if we wish to investigate the more occult relations subsisting between matter and force; to determine, for instance, whether the molecular condition of a body be in harmony with an equilibrium of its forces; we must seek a far more subtle means of analysis than any which chemistry can furnish. In this (and many equivalent cases that might be named) we appeal to polarized light; and not in vain; for given the one indispensable condition, that the body be capable of transmitting light; we obtain an instant and infallible answer as to whether the molecular arrangement of such body be one of unnatural tension or not.

Now, inasmuch as that the same agency, which can thus deal with pure questions of force, is also competent to reveal to us many of the secrets which nature has locked within those small fairy caskets composing the microscopist's treasures; in the minute organised cell for instance; or the almost invisible germ, that may some day marvellously unfold in colour and form of harmony and beauty; it might well be supposed that the alliance of such an agent as polarized light, with the microscope, would necessarily have led to important discoveries in, and optical developments of minute structure, in almost every branch of microscopical enquiry. Yet this has *not* been the case—I mean to any extent at all commensurate with the powers of either agency singly. I apprehend, however, that the reason of this is rather to be sought in the inefficiency of the means hitherto employed for the application of polarized light in microscopical inquiries, than in any deficiency of power in the combination itself; and I have good reason to believe that the instrument which I shall presently have the honour of describing; and which I have named (as in some measure indicating its nature) the Ratio-Micro-Polariscope; will be found to place polarized light in a more important position than it has hitherto occupied as an agent in microscopical research.

Knowing that I have the honour of addressing many gentlemen who are perfectly familiar with optical science, I wish to express the hope, that I may be pardoned for prefacing what I have to say with a few elementary remarks, relative to the changes that occur in a polarized beam when it suffers double refraction. I feel obliged to do this in order to make the subject *generally* intelligible; but I will endeavour to be as brief as possible; and having thus (to the best of my ability) made the principle of the instrument clear; I will proceed to describe its mechanical details, and its modes of use and action.

When a beam of polarized light passes through any substance possessing the optical power of double refraction, (and I may remark that a much larger number than is usually supposed of the structures falling under our observation *do* possess this power) it is split into two distinct rays, polarized in the same plane. The ray emerging in a direct line with the original beam is called the ordinary ray; whilst that which deviates from the direct course is known as the extraordinary ray; and these two are not only separ-

ated by what I may term a *lateral* displacement; but the extraordinary ray being retarded in its oblique passage through the depolarizing film, emerges (except under certain exceptional conditions) in a different phase of vibration from that of the ordinary ray; in other words, supposing the undulations of the two rays could be made *visible*, moving side by side, it would be seen that the crests and hollows of the one wave were not coincident with those of the other.

Now a little reflection will suffice to show, that if this difference of phase amounted *exactly* to a semi-undulation, the effect of bringing the two beams into collision would be to cause their mutual extinction; inasmuch as that equal forces would thus meet in antagonism at points where they would possess equal advantages, and thus the power of each would be neutralised and destroyed. On the other hand, if, when the two rays emerged, there existed an exact correspondence between their undulations (which could only occur when the thickness of the doubly refracting structure was sufficient to make the phase-displacement equal to a full undulation), they would, if brought together as before, double each other's intensity; in other words, we should simply have the polarized beam in its original form once more.

Now, since it can only occur as an exceptional chance, that any doubly-refracting structure we may wish to view, should possess either the precise thickness necessary to separate the extraordinary from the ordinary ray by an *exact semi*-undulation; or, on the other hand, by an *exact entire* undulation; and as any thickness intermediate between these two extremes must result in an interference between rays only of a certain degree of refrangibility (the *particular* rays in every given case depending upon the *amount* of phase-displacement), we might, at first, suppose that *all* doubly refracting structures, when viewed by polarized light, would yield chromatic effects, except in those portions of the structure which (if any) might chance to possess the exceptional thickness named before.

In practice, however, this is far from being the case; for very many structures, and parts of structures, which can be proved *not* to have the exact thickness needed to produce either total suppression or doubled force of the beam, nevertheless, *do not*, when viewed simply between two polarizing prisms, exhibit any chromatic effects whatever. Yet we all know that many of the structures I now

refer to afford very decided chromatic effects, provided a plate of some depolarizing substance (preferably selenite) of such thickness as in itself to produce colour, be interposed either above or below the object; the details in this case being mapped out (so to speak) by their becoming of a different tint from that of the general field; but as, in order to develope any particular structure in perfection, a selenite plate of a suitable relative thickness must be employed; and since the various tissues that come under observation present innumerable parts, differing in thickness, and in power of refraction; it becomes evident that for the *perfect* development of microscopic details any single selenite possesses but a very limited range. Hence microscopists are generally supplied with three or more selenite plates; and inasmuch as that the power of any such plate can be made to vary (within certain limits) by rotation, the selenites are frequently mounted in cells that can be turned with the finger for that purpose.

The question now arises, how happens it, that such a large number of structures, which give no evidence of double refraction, when viewed between *prisms alone;* furnish very decided evidences of it when selenite plates are superadded? I have never met with any answer to this question; and if I venture to give an explanation myself, it is only because I cannot otherwise convey what my ideas were in designing this polariscope; or show in what manner it is capable of accomplishing what I assume to be needed.

A beam of white light, being composed of a number of rays of unequal wave-lengths, and therefore of unequal refrangibilities, it follows, as before stated, that if there be produced interference between two such beams, when the two differ in phase by any amount short of a semi-undulation, such interference must result in the suppression of a *portion* only of the constituents of the beams, leaving the remainder in great measure unaffected.

But as a beam of ordinary light contains, besides the various coloured or visual rays, certain others, which are of *less refrangibility* than any visual ray—these being the heat rays extending beyond the red; and again, at the other end of the spectrum, others, of *greater refrangibility* than any visual ray, viz., the chemical rays, extending beyond the violet; it follows that if the relative phase-displacement of two beams were either *so slight* as to be only a small fraction of a semi-undulation; or on the other

hand *so great* as to be *nearly*, but *not quite equal*, to a semi-undulation; interference might take place between the two, without, in the first case, any perceptible diminution of luminosity; and in both cases without any perceptible production of colour.

To begin with the violet end of the spectrum: let us assume that a polarised ray, having been split by passage through any doubly refracting substance into the ordinary and extraordinary rays, the former is in advance of the latter—as to phase—by such a distance as *exactly* corresponds to a semi-undulation of the *most* refrangible or chemical rays; then it is clear that if these two beams were brought together by the influence of an analysing prism, the only portions that would be extinguished by such clashing, would be these same *chemical rays*, and under the conditions named, *they* would absolutely disappear.

Next, to go to the other end of the spectrum, and deal with the *least* refrangible, or calorific rays: if the structure viewed were of so much *greater* thickness as to make a difference in phase equal to a semi-undulation of the heat rays, then *these alone* would be *totally* suppressed; and although, in this latter case, the entire beam would also suffer as to luminosity—for a reason that I need not here enter upon—still *no* chromatic effects would be produced whatever.

To take the third case, I will, for simplicity, assume that the particular structure is capable of retarding the extraordinary ray by a half undulation of yellow light: now when the two beams or rays are brought together by the action of the analyser, the yellow will be struck from the spectrum, and the object will appear arrayed in the complimentary tint.

It is evident that a similar result must occur when the phase-displacement corresponds to a semi-undulation of *any* chromatic ray; that ray must at once disappear, and leave such a balance of colour as shall be *its complement* in relation to white light.

If in this description I have been sufficiently clear, the idea I wish to advance, as to the action of the selenites* will now be understood.

I apprehend that in the case of a great number of doubly-refract-

* Not in the production of colour *per se*, but in rendering evident the property of double refraction in details of the structure that before seemed not to possess it.

ing structures—or in portions of doubly-refracting structures of a composite order, such as sections of wood, where there are many varying thicknesses, and many differing tissues—the retardation of the extraordinary ray is either *so small* on the one hand, or *so large* on the other, that the effective clashing, upon revolving the analyser—speaking relatively to *many details*, and *not* as to the entire section—is confined to the two extremes of the spectrum, *i.e.* the chemical and calorific rays.

But it is evident that the major displacement of phase, resulting in the destruction of the heat rays; or the minor displacement, resulting in the annihilation of the chemical rays, may each be so supplemented by a definite thickness of selenite, as to have their influence (previously imperceptible), *carried forward into the region of colour.* The power of the former being so supplemented as to pass the first semi-undulation, and interfere chromatically in the second; whilst that of the latter may, in like manner, be advanced in the first semi-undulation, producing similar results; and thus, both the greater and lesser phase-displacements (of which there was no optical evidence whatever before), become plainly visible by change of tint.

But, inasmuch as that the whole spectrum, as to wave-length, is a graduated amount—one part merging into another; every length of wave, in fact, existing between the two extreme components of a beam of white light—it follows that in order *perfectly* to supplement the innumerable thicknesses of doubly refracting structures that the microscopist meets with, thicknesses of selenite equally innumerable would be needed, *unless something equivalent to these innumerable thicknesses* could be devised.

I am happy to say that the Polariscope I am now about to describe, although not presenting these innumerable thicknesses *actually*, nevertheless *does so virtually;* and may be made to supplement *any* thickness of any doubly refracting structure whatever, and thus exhibit it with the fullest possible efficiency and force.

The instrument admits of such a vast number of combinations that its full powers cannot be at once ascertained; but in my hands its operation has been already most beautiful and striking, and by its means I have developed (optically), in the plainest manner, structures which before were too faint and indistinct to be otherwise than questionable.

Speaking not only from this experience, but also from its mode

of action theoretically, I have reason to place great confidence in its capabilities; yet, at the same time, I am very solicitous that no exaggerated ideas respecting it should be entertained. It must be remembered that the defining and penetrating powers of microscopic objectives, have been developed in so wonderful a degree, that comparatively few structures can altogether escape them; nevertheless, there are often many details which appear but indistinctly, even under the best glasses, and the most improved methods of illumination by common light; and all of these (possessing a doubly refracting structure) can certainly be brought out with marvellous force and distinctness by some particular setting of this Polariscope.

On the other hand, no microscopist need look very far through his collection, before meeting with certain structures that *altogether refuse* to be evidenced without polarisation; but in such cases even polarised light is of little avail, unless certain *exact* conditions, or at all events, a very near approximation to such exact conditions, of the polarised beam in relation to those structures can be commanded. Indeed I have repeatedly observed that when polarised light is employed in a hap-hazard manner, it may indeed paint the object with gorgeous hues; but instead of developing, it too often optically obliterates detail.

It is the aim of the instrument—the construction of which I shall now describe—to displace this hap-hazard mode of operating, and enable microscopists to mete out to each particular structure its own special needs and requirements.

This is what I claim for it, and I believe that in the hands of those who will take the pains to become practically acquainted with its capacities, and have patience to vary its combinations until the correct ones be found, it will prove a valuable aid, not only in study, but also in original research.

The instrument consists of a frame carrying a Nichol's prism and three plates of selenite. The prism is arranged in a rotating collar, and the selenite plates above the prism are fitted into moveable cells, toothed around their circumference.

At one side of the apparatus there is fixed a metal pillar, upon which are arranged three toothed wheels, which only move in unison; and the toothed selenite cells are so arranged as to size, that they gear into these pillar wheels, and take motion from them; whilst, at the same time, the relation between the wheels is such,

that during *one* revolution of the first selenite, the second accomplishes *two*, and the third *three*. As a matter of convenience a fourth wheel is added, cut with the oblique teeth, needed to gear into a four-threaded driving screw. This latter being the means of giving motion to the whole.

Over the selenites is placed a condenser, constructed on the principle of a Kellner's eye-piece, the field lens of which receives the whole of the polarised beam, and converges it upon an achromatic combination, so that no diaphragm being needed, the entire beam passes to the object.

Lastly, there is an arrangement by which the selenite cells can be instantly ungeared, and turned singly with the finger, so as to have their depolarising axes set in any relative position that may be desired at starting; and in order to make any position certain, and referable for reproduction at any after time, each cell is graduated, and reads from an index on its own bearing.

The circumference of the prism collar is also graduated through a certain range, and there is a small projecting stud in the upper part of the apparatus, intended to fit into a corresponding recess to be made in the sub-stage of the microscope, so as to ensure the apparatus occupying on every occasion the same exact position. Thus the whole optical arrangement, when placed for use in the sub-stage, may always be set at zero; and as a consequence, when once the exact adjustments for developing any particular structures are found, they can be recorded, and instantly reproduced when needed.

Now, supposing the selenite plates to be so locked in the driving wheels that their positive axes all point to zero, it is clear that on turning the driving screw, so soon as the first selenite begins to move, the second will be gradually parting company with it; and the third (as to axial relation), will be in advance of both; and since the rotation of each selenite plate corresponds optically (within the limits of that one plate), to its gradual reduction in thickness; and all three selenites, starting from zero, can only resume that position after three entire revolutions, during every portion of which they are all occupying different axial relations to one another and to the object; it is manifest, that the optical effect must be the same as though a great number of different thicknesses of selenite had been tried in succession.

Thus, in examining any object by polarised light, it is only ne-

cessary to make three entire turns of the driving wheels; and then, if the exact selenite supplement needed for developing the structure be within the compass of the zero setting, *some position* must be arrived at in which the details sought appear with the greatest possible distinctness.

Should not this be the case, the selenite cells are to be ungeared, the plates re-set, with their axes more or less *out of coincidence*, and the former operation repeated, and so on.

It will thus be seen that the number of variations this instrument is capable of producing—variations that may be so conducted as to create a gradually increasing or diminishing effect *in the direction that appears to be needed;* and which variations, starting as they do from known data, and proceeding in known ratio, can always be reproduced at will—are almost endless. The ratio movement, by spreading out the depolarizing axes of the selenites in a pre-determined order (something after the fashion of the opening of a fan), enables the observer *rapidly* to arrive at an APPROXIMATION to the most perfect optical conditions for viewing any particular structure; *and then*, in order to arrive at *absolute perfection* in the development of the details, nothing is needed but a little time and patience, to change the setting, tooth by tooth (in the direction indicated by the previous adjustments), until further change becomes detrimental.

By a very simple notation, fine positions can be instantly recorded and afterwards read at a glance; and although many trials are generally needed to arrive at the *finest effects;* still, when any adjustment giving *superlative results* with any special object is found, such adjustment will prove by no means to be limited to the single object viewed, but also to embrace *somewhere within the limits of a half rotation of the lower prism* (the selenites themselves now remaining stationary) the finest optical development of many other slides containing tissues of the same, or closely allied character.

For example, I found a magnificent setting for exhibiting the cuticle of the Equisetum; and I have no vegetable cuticle in my possession that does not come out *superbly* under the same selenite adjustment, but with a different position of the polarizer.

So in relation to deep coloured entomological objects difficult to polarize, and many others; they class themselves under certain optical heads *as to the settings*, only needing a changed position of the polarizer; and thus a great amount of time and labour is saved; for

the *prism* can be set to its recorded reading *instantly*, whilst the instrument remains "in situ," in fact, without any disturbance of the general arrangements at all.

Lastly, by means of this polariscope the elementary colours can be mingled in any order or proportion that may be desired; so that any coloured field whatever, of absolute uniformity throughout, from the dirtiest brown to the deepest and purest azure blue (even by lamp light), may be produced instantly by making a known setting.

I had the pleasure of showing the instrument in action to our President a few weeks back, and on producing, by an immediate adjustment, this pure lovely blue of which I speak, he exclaimed, "What a background for Guido's Angels!" Perhaps one of the happiest expressions for mentally suggesting "the pure azure" that could be devised.

In now bringing the subject to a close, I will only add, that I might say much as to the practical use of this polariscope and its results; but I abstain from any further remarks, feeling sure that I must already have tired your patience to the fullest extent that I can feel justified in doing.

EXPLANATION OF PLATE X.

Fig. 1.—Vertical View; Polariscope with selenites locked in gear ready for use in the microscope.

Fig. 2.—Plan View; Polariscope with selenites ungeared for making a setting.

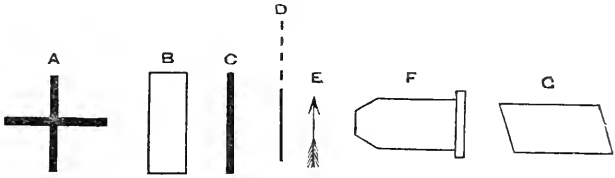
On a New Analyzing Selenite Stage.

By W. Hislop, F.R.A.S.

(Read August 27th, 1869.)

The method of illuminating objects by means of a polarized beam of light has long been before microscopists, but little has hitherto been done to make this system of microscopic examination available for scientific investigation, or in other words, for real work. It has indeed been very successfully used for bringing out the beautiful play of light, shade, and colour, exhibited by many objects having a doubly refracting structure, and many contrivances have been adopted for making its application for these purposes more complete and perfect. Beyond all this, however, there is a value to be attached to its use which has been, as yet, appreciated by comparatively few microscopists. This may be due partly to the manner in which the apparatus is generally arranged, giving little facility of adjustment to suit different conditions, and consequently often producing the impression of uncertainty on the mind of the manipulator, as to the result to be obtained.

Fig. 1.



In order to point out how this uncertainty may arise, I must, for a moment, recall the conditions of polarization. Let A, Fig. 1, represent an ordinary beam of light, either daylight or emanating from a lamp. B is the polarizer. This may be a piece of glass blackened at the back, and used as a reflector, or it may be a bundle of thin glass plates similarly used, or placed at an angle with the axis of the beam of light, which is then partly transmitted and partly absorbed. It may be a thin plate of tourmaline or a

film of Herapathite through which the beam of light is transmitted, or it may be a Nicol's prism constructed of Iceland spar, in a manner which I need not now describe. The last three polarizing media are those which are generally used for the microscope, and the Nicol's prism most frequently of all. Whether the polarizer is a reflector or a refractor, the beam of light is so dealt with that one part is absorbed, and the other part, which is available for illumination, is in a modified condition, which is called polarization.

C is the polarized beam of light; the object is placed at E; at F is the object glass, and above this, either in the body of the instrument or above the eye-piece, is another Nicol's prism or plate of tourmaline, which is called the analyzer. If the object is examined when illuminated by polarized light no effect is observed, except a diminution of light, until the analyzer is applied. If the analyzer or polarizer be now turned round, all the light will be stopped out in a certain relative position, unless the object possesses a doubly refracting structure, when its details will be shown with more or less brilliancy or more or less colour, in accordance with its own peculiarities of structure. A very great number of objects possess this depolarizing power, as it is called, but some in a very feeble degree, and many structures will possess this power unequally, so that one part may be seen while other portions are invisible, until we use additional means of shewing them. This is effected by adding, below the analyzer, but above the polarizer, a plate of selenite (D, *Fig.* 1), a doubly refracting mineral, selected because of its easily splitting into films. This thin plate of selenite has the effect of assisting depolarization, and thus causing many interesting details to start forth to view, which previously were unseen.

But it is here necessary to notice that everything depends upon the thickness of the plate of selenite. One thickness will give blue, and upon the revolution of the analyzer or polarizer its complimentary colour, yellow,—another will give red and green, and so on. But the mere production of colour is not sufficient. The thickness of the plate of selenite and its consequent effect must be adapted to the depolarizing power of the particular object. This, however, is an unknown element which can only be determined by experiment. Our apparatus should therefore be capable of adjustment as a test or analyzing instrument.

The effect of a thin film of selenite to which I have alluded is

due to what is called interference of the rays of light. This may be briefly described as a splitting and consequent disturbance of the vibrations of the ray, which is effected in the case before us by the introduction of a thin plate of a doubly refracting substance.

If I have been fortunate enough to make myself understood, it will be seen that the introduction of the selenite is not merely, or chiefly, to colour the object, but in fact to render evident details not before visible. It will also be readily understood that the polarizers, namely, the prism, the selenite, and the object, should be as close together as possible to get the greatest certainty of result, and to prevent prejudicial effects from other causes.

But further as to the selenite. I have stated that certain colours are produced by films of a certain thickness, and if a film so producing a certain colour, say blue, be caused to revolve horizontally, the tint will vary in intensity only; at one particular position, the least possible trace of colour will be seen. In the ordinary way of arranging the selenites, a film mounted on a glass slide is laid on the stage above or below the object. The effect now produced depends upon the relative position of the axis of polarization of the object, or of its various parts, and that of the selenite. Most probably the various parts of the object have different axes of polarization, and in order to bring them out, the object or the selenite, as well as the polarizer and analyzer, should be capable of rotation while the object is under observation, the object itself remaining stationary. The effect of rotating the selenite will be to bring first one and then another part of the preparation into relief, as shown by the varying tints of colour.

This effect cannot be produced, nor the object properly examined if the selenites are not capable of rotation.

In the same way interference may be effected with films of selenite of different thicknesses, superimposed on each other. One will give one particular tint, and if another be superimposed, the tint due to the joint thickness, or to the difference between the two will be given. These films may be capable each of giving a definite colour, but if we place them so that their axes of polarization coincide, no colour will be seen. Rotate either of the films, and its peculiar tint will become visible. Rotate two or more backwards and forwards, and a combination of tints may be obtained, and thus, with three films of selenite, all the colours obtainable by interference can be got in the field of the microscope.

Some years ago the late Mr. Darker constructed an apparatus, which he called a selenite stage. This consisted of a hollow plate of brass, in the centre of which was a cell capable of being revolved around its centre by means of a tangent screw. Into the cell three selenites, inserted in thin brass rings, were dropped. On the edge of each of the rings the axis of polarization of the contained selenite was marked, so that the axes of each might be made to coincide, or they might be placed at any relative angle. The plate so prepared was then placed on the stage, and the selenites revolved together while the object was over them. The important element of rotation was here provided for; but the amount of interference, and therefore the actual tint could only be changed by removing the object, taking out the selenites, and replacing them at different relative angles. Subsequently the selenites have been mounted in separate moveable rings placed under the stage. This method secures separate rotation, but is not convenient for rotation together. The position of the selenites cannot be conveniently noted, and they are too far from the object.

Having been for some time engaged in observing the characteristics of microscopic crystals, I found it desirable to provide some means whereby, without separating the elements of the polarizing combination to any appreciable extent, all the adjustments for interference and tint should be effected without disturbing the object in the slightest degree. I wished, in fact, to place my object on the stage, and examine it there under every possible variation of the polarized beam. In conversation with Dr. Dempsey I found that he also had experienced the need of an apparatus for a similar purpose, in examining microscopic preparations of different classes, and I was urged by him to contrive such an instrument.

The result was the apparatus of which you have a diagram before you, and which was first exhibited to the members of the Club here, and subsequently at the soirée of the Old Change Microscopical Society, Feb. 15th; at our own soirée on March 12th; and at other meetings, by Dr. Dempsey and myself. *See Figs.* 2 *and* 3 (on next page).

I have endeavoured, by this instrument, to give the selenites every possible facility of adjustment, not in one direction only, but backwards and forwards, together and separately. It consists of two plates of brass, forming a cell or shallow box. In the centre of these plates are two circular orifices, in which, and between the plates,

revolve three toothed rings, forming three separate cells. The lower one has a projecting flange on the lower side, which revolves in the lower orifice. The centre ring has also a flange, which turns in a recess in the lower ring, and the upper one is kept in place in a similar manner. From the right edge of the plates project two discs with milled edges, which are each divided into eight parts, numbered alternately 1 to 4. On the left edge there is a similar disc.

Fig 2.

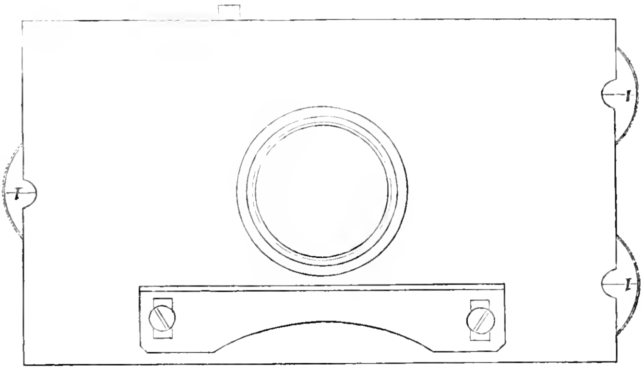
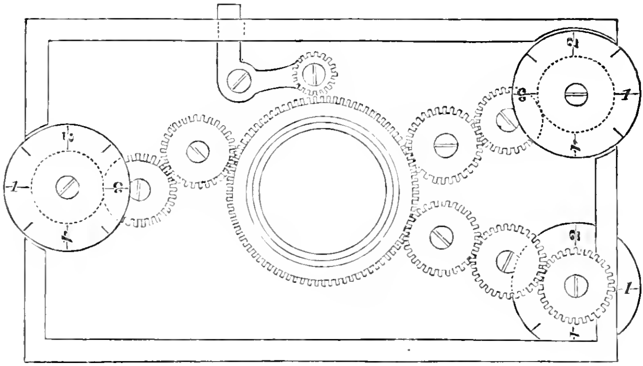


Fig 3.



Each of the toothed rings in the centre is connected with a small toothed wheel on the under side of each of these discs, by other toothed wheels, so that when either disc is turned its corresponding ring also revolves. The selenites

are mounted in thin brass cells of different sizes to fit the three cells, each selenite to its own cell, the lower one being the smallest; a pin or stop being so arranged that the selenite will only drop into one fixed position with regard to the cell. By means of the toothed wheels the selenites are then arranged with their axes of polarization parallel to each other, at the same time that the figure 1 on the discs appears outwards. The upper plate is then screwed on and the adjustments are complete. The selenites not being fixed in the revolving cells, are easily removed for cleaning, and as easily replaced, and when the discs are all arranged to show the figure 1, and the polarizer and analyzer placed in the proper position, we have the nearest possible approach to white light. In order to effect this more readily both polarizer and analyzer should be marked.

A lever, having a small toothed wheel attached to it, is placed at the top, by moving which all the wheels are placed in connexion, and the whole system may be revolved by turning either of the discs.

By registering the position of the graduated discs by the aid of the engraved numbers, any required effect may be reproduced by simply placing the discs in the same relative positions. This can be done by simple inspection, without removing the object or the selenites. In fact, a table may be prepared, indicating the different tints to be produced by any particular position of the numbered discs.

The instrument can be used with any microscope, requiring no especial fittings, and could also be used with a telescope, for analyzing the light of the heavenly bodies.

I must confess that the results obtained even exceed my anticipations. In addition to much more being brought out in consequence of the adaptation of the depolarizing power to the object, there is also an amount of exquisite definition at command which it is exceedingly gratifying to the observer, and which is also suggestive of some points in illumination, to which I may be able to advert in a future paper.

I have named the instrument the Analyzing Selenite Stage, in consequence of its possessing the property of optical analysis; and in another form of it I have an arrangement whereby either one, two, or three films may be withdrawn from the field without interfering with the mechanical action.

On a New and Simple Method of Micrometry.

By John Matthews, M.D.

(*Read August 27th*, 1869.

I wish this evening to lay before you and describe a new and simple method of micrometry. I had some idea of calling it "a rough and ready method," but am scarcely justified in that, since it really is capable of considerable precision. Of this I leave you to judge for yourselves, when I tell you that I have by its aid counted the markings in *Pleurosigma formosum* and *angulatum* easily, and that this has been done not only by myself, but by a person totally unaccustomed to microscopy, even of the most ordinary kind.

Perhaps I ought to preface my description by stating that, in my opinion, it is incumbent on every one who seeks to introduce a new method into the pursuit of a science, or the practice of an art, to justify it by stating what he conceives to be the defects or inconveniences of the existing methods, and then to show how he proposes to remedy them.

The errors, then, which may result from the present modes, are of three kinds. 1stly, from their principle. 2ndly, from the faulty construction of the instruments used. 3rdly, from inaccurate observation or manipulation. And here I will acknowledge that there is no doubt that very good, nay, the best possible, work has been done in the present way by experienced observers; yet it is surely most desirable that even the tyro should have at his command the greatest possible power of ensuring precision, with the least chance of error. It is scarcely necessary to speak to an audience like this of the present modes of micrometry, since they are well-known, and as well described in the pages of the admirable manuals of Carpenter, Hogg, and others, whose treatises are in every one's book-case. Suffice it to say, shortly, that their general application has been to the eye-piece, where Dr. Carpenter affirms that they may be most advantageously used; but I venture to think this at least doubtful, as I shall, by-and-bye, endeavour to show you.

The basis of nearly all micrometrical measurements has been the comparison of the graduations of the eye-piece micrometer with those of one on the stage having a known value, and the absolute value of those of the eye-piece cannot be known until then, because their indications necessarily vary, with the power of every objective with which it is used, and, if more than one eye-piece be adapted to the use of the micrometer, of every eye-piece also. A calculation thus becomes necessary for every separate objective, and as no two, even from the same maker, or of the same nominal focus from different makers, are exactly alike, the table which has been made for *one* instrument and *one* set of powers cannot be employed for another set. It is evident, then, that every measurement is relative or indirect, not absolute. Surely this is likely to be a source of error, therefore a defect. I will not deny that the needful comparison between the two scales once made and tabulated, this method may be absolutely correct, if the graduation of the stage micrometer be true. But I venture to think that it would be far better to dispense with that in the eye-piece, and measure only from or by that on the stage—as I propose to do—and thus eliminate at least one possible and probable source of error.

The next defect of the present methods is, that, depending as they do on the use of a properly ruled slip of glass inserted into the eye-piece at the focus of the eye-glass, and that slip having a sensible thickness, the definition of all powers to which it may be applied is impaired,—of the highest most, and therefore precisely in those cases where micrometry is most useful, and accuracy most desirable. Hogg observes (p. 54) that the Micrometer should not be applied to too deep an eye-piece, "for it is essential to preserve clear definition." Are not, then, those means inherently defective in practice which will not admit of application to all cases with equal accuracy and facility? Another possible source of inaccuracy may lie in the vagueness of the starting *point* (if I may fairly use such a phrase), for measurement by *two* scales.

All the rulings, on even the finest and best instruments, have a very sensible dimension, which of course seems to increase with the magnifying power. The exact apposition, then, or *collimation* of lines in each of the micrometers is not a very easy matter. It is, besides, well known that there often exists a curious optical illusion in the transit of one of two bodies having sharp edges, over another, under which it does not seem to move for a small

time, and then to jump over a space. This does not happen when a *point* approaches a line; or at least, to a far less amount, if at all.

Lastly, the present modes mostly require the assistance of a draw-tube, in order to reduce or increase the value of the divisions of the eye-piece micrometer to some definite relation to those of the stage micrometer, so that it is necessary to enter in the table which I have mentioned the length to which the tube has been drawn out. Now, it is not every microscope that is provided with such a convenience, although it is always present in the best and most costly (adding, of course, to their cost). Besides, the use of the draw-tube certainly impairs definition.

Sir, I think that you and all my hearers will agree with me that if any approach to equal precision can be attained in any science or art, by the substitution of simpler methods or means, for those in previous use, whereby also a saving of time and expense is effected and facility of manipulation increased, a great benefit is gained, since the value of that precision which proper and accurate measurement, *easily* effected, infers, cannot be overrated. In proof of this, I need only refer to the labours of Mr. Whitworth in that direction. It is on this plea that I submit my method to you. It can, I think, scarcely be called an invention, being rather an extension of the uses, or an adaptation to new uses of a well known contrivance, called "Quekett's Indicator," as made by Messrs. Beck, and it is this little instrument which I have pressed into a new service, in which I hope to be able to show you it behaves very well. This new service is micrometry of a *direct* and *positive* kind, by the aid or use of the stage micrometer only. Here, perhaps, I may be permitted to observe that I am glad that I have not added to the *number* of instruments, but have merely developed the uses of one of those already existing, for this has been hitherto employed merely to point out some particular object, or part of one in a field, to another observer. It consists of a fine pointer, so fitted in the interior of an eye-piece, at the focus of the eye-glass, as to be capable of being turned into or out of the field by means of an external quadrant, properly milled, or, preferably, by a small handle for the sake of greater power over it. Now, my plan is to employ two of these indicators, either on opposite sides of the eye-piece, or side by side. I prefer the former mode, as in

that which I show you. In this the points are so curved in opposite directions, as to form two semi-circles, which may either be turned quite out of the field, or be placed with their points in apposition, so as to form a curve like the letter S, being capable, of course, of assuming any intermediate position, so as, apparently, to include an object between their points. They form, in fact, a pair of callipers, and their uses are exactly the same. An object having been placed on the stage, the points are advanced on either side of it until they are in exact seeming contact with its edges. If it be irregular in shape, or if the long diameter do not correspond with the position of the pointers, the eye-piece must be rotated until they attain the desired position. The object is then removed, and the stage micrometer substituted, when the dimension may be directly read off. This operation is exactly repeated for as many measurements in all directions as may be required, the eye-piece being rotated after each such measurement as does not leave the pointers in a line with the divisions of the scale. If it be required to count striæ or markings of any kind, then the points are to be set at some definite distance apart by the stage micrometer. The object is then to be substituted for it, and the counting effected. I cannot conceive a single case to which this method is not easily applicable. Its cost is not great, for the pair of points may be applied to any eye-piece for a price not exceeding ten shillings, and its ordinary use is in no way impaired thereby. If greater delicacy be required, the points may be moved by tangent screws, but these would seriously increase the cost, and are really scarcely necessary. Indeed, an economy is the result of this instrument, since an eye-piece micrometer would cost at least double the above amount, and must, after all, be referred to a stage micrometer. I had at first some difficulty in getting points sufficiently fine, but Mr. Hislop has suggested to me the employment of fine pendulum spring wire, pointed by a blow of a hammer in one direction, and has very kindly assisted me by carrying his suggestion into effect with great tact and delicacy.

To sum up, I may say that the advantages which I claim for this invention are these :—

1st. *Direct* measurement, *i.e.*, one without an eye-piece micrometer, requiring therefore no comparison or correction.

2nd. The absence or removal of any cause of loss of *definition*, viz., a slip of glass in the eye-piece.

3rd. The use of a *point* for collimation, with a line, instead of one line with another.

4th. That the draw-tube is discarded for that special use as unnecessary, and likely to impair definition.

5th. Greater general accuracy and facility even in the hands of the experienced as well as of the student.

And lastly. Decrease of expense.

I may conclude by observing that I have said nothing as to the thickness of covering glass, since it is obvious that that must be taken into the account, whatever methods be employed.

On Oysters and Oyster-spat. By G. W. Hart.

(Read August 27th, 1869.)

If an oyster be opened (on the flat shell) in the month of April, there will be found on the left side of the heart a swollen gland extending downwards for a considerable distance. This gland is at this period filled with spermatozoa of the usual tadpole shape, and in immense numbers. About the middle of May they disappear, and the all important question which awaits solution is whether these spermatozoa are discharged into the sea for impregnation of the ova of other oysters, or are passed simply into the ovaries of the same animal.

Dr. Kelaart adheres to the first view, and at present that is also my opinion, and if it be the correct one, then the clustering together of oysters into banks is at once a provision for this mutual impregnation, and a consequence of the mode by which the young are discharged. After the discharge of the spermatozoa, veins begin to appear in the ovaries, which soon cover as with network, the whole body of the oyster, producing an appearance never seen when the fish is simply fat. These veins become gradually thickened and from being filamentous in form, become corrugated or beaded, and still later they are seen to be convoluted.

Up to this date the ova are attached, but now the entire mass appears to be set free, and if the ovary be cut, the eggs are discharged in a granular state, having in a mass the appearance of a rich cream. As the more forward ova are pressed along this canal they receive their cilia, and become capable of locomotion, if placed in water; they have as yet no appearance of shell and retain their granular form, and if injured by pressure each egg may be seen dissolving into its constituent atoms, which retain for some little while an independent vitality,—no organ is yet apparent.

When the most advanced have reached this stage they are passed into the mantle and receive their protecting shell, which appears to be deposited by the parent oyster from the mucous which is found more abundantly in that organ at this season than at any other time. The ova may now be fairly considered to have reached the

embryo state, their colour is rapidly changing, the internal organs become gradually developed, and the stomach and liver become apparent as a dark spot, which causes the deeper tint of the mass of embryoes.

When warm weather sets in early in the spring, immense numbers of the young in this state are to be found in the sea, and not unfrequently even in a more backward condition. The discharge of the young in these stages appears to me accountable for only in this way—that from excessive heat the production of ova has been very rapid (and the ovaries have been known to burst and the animal to die under these circumstances); the first eggs are, therefore, involuntarily extruded from the inability of the animal to contain the whole for the period necessary to the perfecting both of the shell and internal organs of the embryo, and when this is the case the young necessarily perish.

When perfect, the young *en masse* are of a deep grey, or nearly black tint, the stomach, heart, liver, and intestine clearly visible through the transparent shell. The dark parts immediately at the back of the ciliated pad become more developed, and being seen more plainly through the transparent shells, is the cause of this darker tint.

By putting a little carmine into the water the functions of all the organs are beautifully seen, and they are found as perfect in the young as in the adult oyster.

The projecting pad, with its cilia, serves both for propelling and feeding, the oyster moving forward with open shells and expanded mantle, into which the cilia draw the more minute objects which form the food of the oyster, among which I have found most of the marine species of diatomaceæ, and some few crustaceæ. In the claires of Marennes, where oysters are green, I found the most plentiful to be *Achnanthes longipes*, and *Surirella ovata*, whilst at Hayling the greenness appears to be caused by the presence, in immense numbers, of *Gyrosigma formosa*.*

The question whether an oyster is capable of self-impregnation is one of the utmost importance. Upon it hinges the problem as to improving the races by judicious crossing, which is obviously impossible if each oyster breeds without assistance from another. On

* The distinctive colour of recent diatoms is brown.—*Ed.*

the other hand, if it be necessary to saturate the water at some early date with spermatozoa for the general impregnation of the bulk of oysters, it is certain that to reduce the number beyond a certain degree, and so remove the individuals to a greater distance from each other, is destructive to the fertility of a bank, as the chances of the oyster becoming fecundated by the spermatozoa of another is reduced to a very low point.

The young oysterling having been ejected by its parent in a perfect state—in favourable seasons *at once* attaches itself by its pad to the first object it meets with; if it be an unsuitable one—mud—it perishes. If suitable a growth of shell immediately takes place, and it is *this layer of shell matter that forms the attaching medium.* There is no requirement for a special organ for the purpose of attachment, and therefore none exists—and when one layer of shell has been made another follows it, and so on continually, with small periods of rest. So that the point of attachment, which was at the first in front, becomes in a short time left in the rear, and it is this which has led to the notion that the oysterling is attached in the first instance by the *heel* of the shell.

Mr. B. T. Lowne regarded the question of self-impregnation as one of very great importance; he said he could see no reason why oysters should not be self-fertilizers under some circumstances, although under others a cross between two individuals might take place; when the spermatozoa of an oyster are discharged into the water it is almost inconceivable that they should not fecundate the ova of that oyster, unless some provision of a mechanical kind existed to prevent it, and it is difficult to understand what that provision could be which would not equally, or almost equally, render fertilization from another individual difficult or uncertain. We know that in plants, which are almost all hermophrodites, self-impregnation is the rule, and yet a great variety of means are provided for effecting a cross between two individuals. Whilst from the valuable researches of Mr. Charles Darwin it appears that even should the pollen of another individual come in contact with a stigma which has already been sprinkled with pollen from anthers in the same flower, even though the pollen tubes had

already penetrated a large portion of the style, fertilization is much more likely to be effected by the alien pollen—that, in point of fact, the second or alien pollen is pre-potent over the first.

If the same be the case with oysters, which appears likely as giving the species the best chance of surviving, it all becomes a question of pre-potence. Where the oysters are scattered or solitary, self-fertilization would have a great effect in preventing extinction; whilst where they are closely packed together, the water loaded with vast numbers of spermatozoads, assisted by the law of pre-potence would effect cross-fertilization, the effect of which would be most undoubtedly to strengthen and improve the race.

President's Address, delivered at the Annual Meeting, July 23rd, 1869. By Arthur E. Durham.

Gentlemen,—

My prolonged term of office as your President is now all but at an end. The ballot is going round for the election of my successor. With your permission I will avail myself of the minutes that remain to me to say to you a few farewell words.

In the first place, I thank you very sincerely for the consideration, courtesy, and kindness you have so uniformly shown me. You have rendered my duties in this chair very easy and very pleasant.

In the second place, I must beg you to allow me to express thus publicly my high appreciation of the cordiality and hearty good will with which your committee and officers have co-operated with me in endeavouring to promote the success of our meetings, and to advance the general interests of our Club. To our indefatigable Secretary, Mr. Bywater, my acknowledgments, and, I venture to add, your thanks are especially due. It is impossible that any one who has not occupied the position that I have done, can know the attention and devotion that Mr. Bywater has displayed, and the amount of work he has done on behalf of the Club. He has been instant in season and out of season—ever ready to do all he could. He has laboured well, and he has laboured successfully. Personally I must express my obligations to him; and I may be permitted to add, I heartily wish that success similar to his may attend the efforts of your excellent new Secretary, Mr. Charters White.

In the next place, Gentlemen, I beg to assure you of the pleasure I have felt in fulfilling or attempting to fulfil during the past two years the various duties that have devolved upon me as your President. There must always be pleasure in being prominently associated with undertakings which not only deserve, but actually achieve success. And the success of the Quekett Microscopical Club, I venture to believe, is not only well deserved, but is established beyond dispute. It seems to me that the success of the Club is due to the fact that it has supplied a want which was becoming felt by many young Microscopists, and that it has done so without any undue assumption or any ambitious attempt to occupy

a higher or more authoritative scientific position than could properly appertain to it.

Allow me to read to you some extracts from the original Prospectus of the Club:—

"This Club has been established for the purpose of affording to Microscopists, in and around the Metropolis, opportunities for meeting and exchanging ideas without that diffidence and constraint which an amateur naturally feels when discussing scientific subjects in the presence of professional men."

"The want of such a Club as the present has long been felt, wherein Microscopists and students with kindred tastes might meet at stated periods to hold cheerful converse with each other, exexhibit and exchange specimens, read papers on topics of interest, discuss doubtful points, compare notes of progress, and gossip over those special subjects in which they are more or less interested; where, in fact, each member would be solicited to bring his own individual experience, be it ever so small, and cast it into the treasury for the general good. Such are some of the objects which the present Club seeks to attain."

How far these objects have been attained, and are still kept in view, you, Gentlemen, know by your own experience.

The Prospectus further sets forth that it is hoped that "occasional Field Excursions, at proper seasons, may be organised, for the collection of living specimens;" "that a library of such books of reference as will be most useful to enquiring students may be acquired;" and that "trusting to the proverbial liberality of Microscopists, a Comprehensive Cabinet of Objects" may be got together.

Then comes the modest but appropriate conclusion,—"by these and similar means the Quekett Microscopical Club seeks to merit the support of all earnest men who may be devoted to such pursuits, and, by fostering and encouraging a love for microscopical studies, to deserve the approval of men of science and members of more learned societies."

Now it seems to me that the worthy objects thus set forth are being worthily carried out. Moreover, I believe that by adherence to these objects and by steady persistence in the course thus indicated, the present success of the Club may not only be maintained, but may be assuredly increased in the future. Already many societies have sprung up in imitation of this; and everywhere,

both in this country and on the other side of the Atlantic, the results have been most encouraging.

In this busy, work-a-day world, in this metropolis especially, it is well for men to have some occupation for head and hand, out of and apart from their every-day occupations and pursuits. It is miserable for a man to have nothing to turn to for diversion and refreshment—for amusement in the high and proper sense of the word—from his daily avocations.

In my address to you last year I dwelt at some length upon the educational uses of the microscope, and pointed out the manner in which working with the microscope tends to encourage the use of the hands, to develop the powers of observation, and to exercise the faculty of scientific interpretation. I now venture to allude to the microscope as affording one of the best and readiest sources of diversion from the anxieties and cares of business, and the brain wrack of professional life. I might go even further. A valued friend of mine, who is slowly dying from one of the most painful and tedious maladies to which humanity is liable, and who knows but too well the hopelessness and irremediable character of his disease, writes to me but the other day in these words :—" In the intervals of more serious thought I solace myself by working with my microscope, and in contemplating the beauties and wonders it reveals." *

The objects with which the microscope make us acquainted are endless in their variety, inexhaustible in their interest, and almost incomparable in their beauty.

Moreover, new methods of research, and new aids to observation are being devised before the capabilities of the older and well-known methods are exhausted. Need I remind you that since I addressed you last year Messrs. Powell and Lealand have developed to a wonderful extent the applicability of the immersion principle, and have shown us with comparative ease what we have never seen so well before ? Need I remind you of the clear and almost perfect demonstration of the true structure of the Diatom-valves and their markings, which has been given by my friend, the President of the Royal Microscopical Society, by means of his new method of prism illumination ? And now this evening you will

* Since this address was delivered a paper has been communicated to the Club by the friend to whom I allude. This paper was read on the evening of the day on which the author's death was announced in the *Times*.

hear a description of an arrangement by which researches by means of polarised light may be much facilitated, and rendered, in some respects, much more accurate. For the exquisite beauty of the results which Mr. Field's method is capable of exhibiting, I can most thoroughly vouch, and to some extent I believe you will speedily have the opportunity of judging for yourselves.*

It is an old story that Alexander wept because he had no more worlds to conquer. Truly it must be a long time ere the Microscopist can have cause to weep on any such account. No field of microscopical research is yet fully explored, much less exhausted. Further search finds everywhere something fresh. New methods of illumination are constantly showing what has been already seen in some new light, and some new interpretation is being suggested. New methods of preparation or research exhibit plainly what before was obscure or altogether invisible. And when all is done, it still seems that the Microscopist may almost create, as it were, new worlds for himself. This consideration—this vague suggestion—brings me to a subject upon which I wish to take the opportunity of saying a few words to you. The subject to which I allude is that which ordinarily goes by the designation of "spontaneous generation." But surely a more obvious misnomer was never applied to any series of phenomena, imagined or observed.

Now a belief in the so-called spontaneous generation of living creatures is of very ancient date. But the earlier ideas on the subject can only be regarded as so many fanciful interpretations of imperfectly observed phenomena.

Of late years, however, by the aid of the microscope, some of the questions involved have been repeatedly submitted to something approaching to precise investigation. And the results obtained, although by no means final, are yet very suggestive, and full of interest.

It has been clearly established that all the higher animals and plants derive their origin from similar and previously existing organisms. Upon this point there is no longer any possibility of dispute.

But with regard to the very lowest forms of life—the Bacteria, Vibrios, Monads, and such like—it is somewhat different. Their mode of origin still appears to be at best but doubtful. Two diame-

* See Paper by Mr. Field on the "Ratio-Micro-Polariscope," at page 215. It is only right to add that Mr. Hislop has already exhibited a somewhat different and simple arrangement, devised by himself, by which similar advantages are obtained. A full description was read at the Meeting on the 27th of August, but the instrument itself was shewn long previously. See p. 225.

trically opposite opinions are stoutly maintained by their respective adherents.

On the one hand the Panspermists assert that every living thing, no matter how minute in size, how simple in form, and how low in organization, originates from some similar living thing. *Omne vivum ex ovo* is their physiological shibboleth. Every living thing is developed from a living germ, and therefore if living things are found in decomposing infusions the living germs must have been here previously. Such is their method of reasoning. It is useless to point to experiments in which infusoria have been found to appear in infusions in which all traces of previously existing life have been destroyed, and from which all fresh germs have been rigorously excluded. To the Panspermists the appearance of living organisms proves the previous existence, or subsequent entrance, of living germs. "Without such living germs," they ask, "how can the living organisms become developed?"

On the other hand, the Heterogenists repudiate all dogmas, and rely upon their experiments and observations. They subject infusions of vegetable and animal matter to a sufficiently high temperature to destroy all life. They exclude air and the germs that it may contain, either by hermetically sealing the vessels with which they experiment, or by interposing tubes filled with sulphuric acid. They watch, and find that in spite of all their precautions the infusions, if exposed to light and warmth, sooner or later become filled with living organisms. "Whence come these?" they triumphantly ask. "How do they arise, if not by a process of spontaneous generation?"

Thus the Panspermists and the Heterogenists contend for their respective positions. The battle is fought with all the warmth and feeling of a polemical or theological controversy, rather than with the calmness and candour proper to a scientific discussion.

It would be altogether out of place for me to attempt, on this occasion, to give you even a bare sketch of the history, progress, and present aspects of the controversy.* And I certainly shall not

* I would refer those who may read this address to a very able series of articles that have appeared in the "British Medical Journal" for the present year, on the "Origin of Life," and also to the original papers of Pasteur, Pouchet, Jolly, Musset, Mantegazza, and others, communicated to the French Académie des Sciences, and especially to Dr. Bennett's recent contribution to the "Popular Science Review," Jan., 1869, on the "Molecular Origin of Infusoria." Mr. Herbert Spencer's appendix to the first volume of his "Principles of Biology" must also claim attention. A resumé of the whole discussion has been published by M. Pennelieu, in an independent work entitled "L'Origine de la Vie." Paris, 1868.

be so bold as to express any bare, crude opinions upon points at issue, which I have neither time, opportunity, nor ability, fairly or fully to discuss.

But with all deference, and subject to all correction, I would venture to take up the question at the point at which the Panspermists leave it, and beyond which, so far as I know, the Heterogenists have not generally advanced. And I would submit to you a few considerations which occur to my own mind as indicating the direction in which possibly an answer may be found to the question, "How can living organisms originate if living germs are absent?"

In order to render clear the view I would suggest to you, I am afraid I must resort to a somewhat roundabout mode of explanation.

In the first place. That which we call matter exists, as we know it, in various forms and combinations. Some forms are so simple that they have not been yet separated into simple forms, and they are therefore termed elementary. Other forms are so complex and composed of so many elementary forms, combined in such an intricate manner, that no satisfactory analysis has yet been made. These various forms of matter may assume, or may be made to assume, various physical conditions. Thus they may become heated, electrical, magnetic, or luminous. And some of the forms of matter may become living. Now the comparative facility with which any form of matter may be made to assume any of the conditions specified, varies with its character and composition. Thus we know that some substances may be made hot, or electrical, or luminous, much more easily than others; and the number of substances that can be readily made to manifest the magnetic condition is very limited. We know, too, that the forms of matter that can become living are also limited in number, and that they present various peculiarities in physical character and chemical composition.

In the next place. A portion of matter in any particular condition may transfer, as it were, to a certain extent, its condition to any other portion of matter in relation with it, provided always that the second portion of matter is free to assume that condition. Thus, if a body in motion comes in contact with another which is at rest, but which is free to move, the second body partakes of the motion of the first, and moves proportionately. So again, if a substance which is hot, or electrical, or magnetic, is brought into

relation with another substance which does not at the moment manifest the same condition in equal degree, but which, nevertheless, is capable of assuming it, we find that the second substance is made to participate in the condition of the first, and becomes hot, electrical, or magnetic, as the case may be. Some substances, again, exposed to the influence of luminous substances in their neighbourhood, become themselves luminous. As witness, for example, the well-known experiment of the phosphorescent butterfly. And again. Some substances, when brought into due relation with the living tissues, become partakers of their vital condition. Thus the dead food taken in becomes a living part of the living body.

But we may go a step further. If a portion of matter in any one of the active conditions we are discussing comes into relation with a second portion which is not capable of taking on a similar condition, the influence exerted is none the less, although the mode of manifestation is different. Under such circumstances the condition is not simply transferred. It becomes, as it were, transmuted. Thus, if a body in motion comes in contact with a body at rest which is not free to move proportionately, the first body is retarded or arrested, and both become heated or electrical —heated especially if the two bodies are of similar nature—electrical especially if they are of different natures. And these conditions are developed to an extent proportionate to the resistance to motion. Some substances, under such circumstances, may become magnetic. Again, if matter, intensely heated, is brought to bear upon a portion of matter in an opposite condition, the first tendency is to cause motion of all the particles of this second portion, and the phenomenon of expansion by heat takes place. But if, from the nature of the particles, they cannot fly apart, or move to an extent proportionate to the influence acting upon them, another transmutation of condition occurs, and they become luminous.

Again. Either directly or indirectly, chemical action or change of composition, which is but an expression of molecular motion, may result from, or give rise to, various transmutations of physical condition. And so too, with regard to the condition which we call "vital." The seed germinates, and the plant developes and grows when its surroundings are in the needful physical conditions, and not unless. The heated and luminous conditions of the dead matter around become transmuted, and add to the sum of vitality of

the living organism. Water, carbonic acid, ammonia, and earthy salts, are taken up by purely physical processes. Under the influences radiating from the sun, and transmitted as physical conditions through the various intervening media, these substances are decomposed. Their elements are rearranged, and becoming constituents of living tissues, may be said to live.

So far I have been simply endeavouring to convey to you, or rather to remind you of what is strictly in accordance with the scientific teaching of the day.

The mode of expression I have used in speaking of conditions of matter, rather than of forces acting upon matter, may be somewhat different to that ordinarily adopted, but may nevertheless be allowed to pass.

If you wish more information on the subjects to which I have alluded, and further illustrations of what I have been stating, by all means read, supposing you have not already done so, Grove's treatise on the "Correlation of the Physical Forces." I do not know any other work of modern times that has done so much to render clear, to establish, and to advance our conceptions of the phenomena of the material world about us. Read also the admirable paper by Dr. Carpenter, in The Philosophical Transactions on the "Correlation of the Vital and Physical Forces."

Thus far we may advance on grounds the safety and stability of which are very generally recognised and accepted.

But now arises the question, "May we not go a step further?" May not the active physical conditions of surrounding matter reacting on certain susceptible substances become transmuted into what we call the vital condition, even though no living germ be present? Nay, further, is it not the fact that they do become so transmuted?

We take material of highly complex composition,—material formed by the vital processes of highly organised beings, and which possesses chemical and physical properties which characterise it. Call this material an albuminoid compound, or call it "protoplasm," or "the physical basis of life," or what you will. We subject this material to the needful surrounding influences. Portions of it undergo decomposition, and sink to lower grades. Other portions aggregate, and assume more or less definite forms, and manifest some of those phenomena which we call vital.

Is there anything startling in this? Is there anything incon-

sistent with what we know in admitting that such transmutation of condition may occur? The sum of vitality of the fully developed being of high organisation is infinitely greater than the vitality of the germ from which it has sprung. Whence has come the increase but from the transmutation and absorption, as it were, of physical conditions reacting from without? And may not similar conditions reacting on the dead products of animal and vegetable life cause portions of such products to assume the condition of infusorial life?

These and such like suggestions and questions I leave to you. I offer neither comment nor answer. But from the Microscopist comment and answer must come, if they come at all. As yet we do not know enough. We must investigate and observe further before we can satisfactorily explain the problems submitted to us, and answer the questions, and set at rest the doubts that arise. We must labour and wait, and sooner or later the light will come, and we shall see clearly what now is dark.

Gentlemen, I thank you very much for the patient attention with which you have listened to me. This is the last occasion on which I shall have the opportunity of addressing you as your President. I wish I could have filled my part better than I have done. I repeat my acknowledgements of your unvaried consideration, courtesy, and kindness. The ballot is closed, and it only remains for me to announce to you the result,—to welcome my successor, Mr. Le Neve Foster, to the office to which you have elected him,—and to resign to him this Chair.

QUEKETT MICROSCOPICAL CLUB.

JUNE 25TH, 1869.

ARTHUR E. DURHAM, ESQ., PRESIDENT, IN THE CHAIR.

The minutes of the preceding meeting were read and approved.

The following donations were announced, and the thanks of the meeting given to the respective donors :—

"Science Gossip," from the Publisher; "Monthly Microscopical Journal," from the Publisher; "Scientific Opinion," from the Editor; "Land and Water," from the Editor; "The Quinology of the East India Plantations," from the Author, John Eliot Howard, Esq., F.L.S., &c.; sixteen slides from Mr. W. H. Golding.

Fifteen gentlemen, proposed at the last meeting, were unanimously elected members.

The President having announced that the next meeting would be the annual meeting, the following names of gentlemen, recommended by the committee for election as officers for the ensuing year, were read :—For President, Mr. Peter Le Neve Foster, M.A.; Treasurer, Mr. Robert Hardwicke, F.L.S.; Honorary Secretary, Mr. T. Charters White, M.R.C.S.; Honorary Secretary for Foreign Correspondence, Mr. M. C. Cooke.

The following gentlemen were nominated for Vice-Presidents, by members present at the meeting :—Mr. Arthur E. Durham, Dr. Braithwaite, Mr. Bywater, and Mr. Hailes.

The President announced that the following gentlemen would retire from the Committee, in accordance with the rules, viz. :—Messrs. Breese, Hailes, Burgess, and McIntire.

The following names were nominated by members to fill the vacancies thus created :—Mr. McIntire, Mr Thos. Crook, Mr. R. May, Mr. B. T. Lowne, Dr. Millar, and Mr. Matthews, four to be elected.

Messrs. Suffolk and Marks were unanimously elected auditors.

Mr. W. H. Leighton gave notice of the following motion :—"That in future the Annual Meeting be held on the fourth Friday in January."

Seconded by Mr. John Hopkinson.

Mr. Cooke read some communications from America.

Mr. Highley read a paper on the Rev. Mr. Reade's method of illumination.*

The thanks of the meeting were given to Mr. Highley.

The following gentlemen were proposed for membership ;—Mr. William H. Allen, Mr. Richard Boyer, Mr. Edwin A. O. Creer, Mr. Samuel Devenish, Mr. William E. Horn, Mr. F. F. Perry, Mr. Thomas Willmer Pocock, Mr. Samuel Atkinson Richards, Mr. James Thin, and Mr. Joseph Trotter.

* Published elsewhere.

JULY 23RD, 1869.

ANNUAL MEETING.

ARTHUR E. DURHAM, ESQ., PRESIDENT, IN THE CHAIR.

The Fourth Annual General Meeting was held at University College, in accordance with the rules.

The minutes of the last meeting were read and approved.

The following, being the Fourth, Annual Report was read, together with the financial statement;—

"In presenting the Fourth Annual Report, the Committee of the Quekett Microscopical Club have great pleasure in again congratulating the members on the continued prosperity and increasing success of the Club. Very considerable additions have been made to the list of members, the meetings have been increased in frequency, and the large attendances thereat have evinced well sustained interest in the proceedings.

"At the last Annual Meeting the Committee expressed a hope that arrangements would speedily be made by which more frequent opportunities of meeting during the winter months would be afforded. This hope has been fully realised. By the liberality of the Council of University College your Committee were enabled to make the experiment of holding extra meetings for conversation and the exhibition of specimens. The success of these meetings was so great that the Council of the College have readily consented to their continuance, in addition to renewing permission for the ordinary meetings during the present year. Your Committee cannot sufficiently express their appreciation of the advantages thus freely conferred upon the Club by the authorities of the College.

"During the year just completed the 'Journal of Transactions' has appeared at the usual quarterly periods. Your Committee trust the objects for which it was projected are being attained, that by it absent members are made better acquainted with the proceedings of the Club, and that it is thus becoming a means of bringing members into closer intercourse.

"It will be interesting to members to be informed that the *soirée* given in March last was eminently successful. It was attended by upwards of 1,400 members and friends, and very many interesting objects were exhibited. The Committee desire to express their cordial thanks to those gentlemen by whose assistance they were enabled to carry out their plans to so successful an issue.

"The papers which have been read during the past year have been full of interest, and have appeared in the Journal as nearly *in extenso* as space would allow. The Committee trust that during the ensuing year an increased number of members will contribute papers embodying the results of some of their investigations.

The slides in the Cabinet amount in number to 1,242, the following additions having been received during the year;—

Mr. Collins	2	Mr G. H. King	4
,, Cooke	427	,, Kitton	1
,, Curties	8	,, Martinelli	1
Dr. Dempsey	4	Dr. Perley	6
Mr. Edmonds	6	Mr. Quick	10
,, Golding	19	,, Russell	18
,, Groves	1	,, Slade	6
,, Hislop	24		
,, Kilsby	1		541

The slides are under the care of Mr. Ruffle, to whom the Club is greatly indebted for the facilities which exist for their proper examination.

Numerous Books of Reference have been added to the Library from time to time by purchases and donations. By the earnest co-operation of Mr. Jaques the books have been very generally circulated on the nights of meeting.

The exchange of slides is now in full operation under the superintendence of Messrs. Bockett, Hailes, Hislop, and Marks, who have succeeded in carrying out the duties that have devolved upon them most satisfactorily. During the past year about 300 slides have been exchanged

"The excursions form a feature in the Club, and their sustained success is a matter for much congratulation. As the result of the well organised arrangements of the Excursion Committee (Messrs. Arnold, Gay, Reeves, and Suffolk) the meetings have been exceedingly well attended, and the localities for exploration have been admirably selected and diversified. It is hoped that together with the fortnightly meetings in the college the excursions have proved sources of gratification to those who have attended them, and of instruction to those who have been enabled to examine the objects collected.

"These excursions afford opportunities for research and investigation such as few other societies in London can supply. Your Committee hope to receive at the termination of this season more copious records of the objects collected, and their habitats, as noted by members, than have hitherto been furnished. They therefore venture to impress upon all members the desirability of assisting in this matter. Such a course cannot fail to be advantageous as well to the observer as to the general body of microscopists. It is intended that the results of the excursions shall form a chapter in the Journal.

"Since the last Annual Report 142 new members have been admitted into the Club, and 12 names have been withdrawn. Consequently the present number of members is 512. If numbers can be adduced as evidence of success the Committee will be justified in offering their hearty congratulations. They believe it is almost unparalleled that 560 members should have joined any society, allied however remotely to science, in the short space of four years, accompanied by so small a reduction by reason of death or other causes.

"These four years of success have left us a legacy in the shape of great responsibilities, which we must perforce accept. If the opportunities afforded to members be great, the demand upon them for increased exertion is proportionanly great.

"Let no one, therefore, work for his own gratification alone, but let each strive to contribute to the general fund of information, ever bearing in mind that whatever he may have met with interesting to himself may be interesting to others also. There is nothing in the field of nature so insignificant but that it may prove of value to some one or other of the members who has accustomed himself to investigate whatever may come under his notice, and who has made

"The fields his study—nature his book."

July 23rd, 1869.

TREASURER'S REPORT.

JUNE 30TH, 1869.

RECEIPTS.	£	s.	d.
Balance in hand at last Audit	62	0	9
Subscriptions received from July 1, 1868, to June 30th, 1869	195	0	0
	£257	0	9

PAYMENTS.	£	s.	d.
Printing and Stationery ...	27	15	0
Postages	12	12	9
Advertisements	4	17	3
Attendants	7	17	6
Property Purchased ...	26	13	3
Petty Expenses	13	12	6
Expenses of Soirée	61	9	4
Journal, Nos. 3, 4, 5, and 6—nett cost	79	3	11
Balance at Banker's ...	22	19	3
	£257	0	9

ROBERT HARDWICKE, Treasurer.

We, the undersigned, having examined the above Statement of Income and Expenditure, and the Vouchers referring thereto, hereby certify that the said Account is correct.

W. T. SUFFOLK,
E. MARKS, } Auditors.

On the motion of Mr. Burgess, seconded by Mr. Hopkinson, it was unanimously resolved that the reports be received, adopted, and entered on the minutes.

The President then delivered an address on leaving the chair. (See page 240.)

The President having appointed Messrs. Suffolk and Quick to act as scrutineers, the members proceeded to ballot for the officers for the ensuing year; after which

The President left the chair, and Mr. Peter Le Neve Foster, the new president, took his place, and made some appropriate remarks upon the occasion.

It was proposed, and carried unanimously, "That the cordial thanks of the meeting be given to the retiring officers for their services to the Club, viz:—Mr. Durham, Dr. Braithwaite, Mr Cooke, Dr. Dempsey, Mr. Roper, Mr. Bywater, Mr. Breese, Mr. Hailes, Mr. Burgess, and Mr McIntire."

It was resolved that the cordial thanks of the Club be given to Mr. Lewis, reporter; Mr. Jacques, librarian; and Mr. Ruffle, curator; and to Messrs. Arnold, Reeves, Gay, and Suffolk, the members of the Excursion Committee; also to Messrs. Bockett, Hailes, Hislop, and Marks, the members of the Exchange Committee.

In accordance with notice in writing given at the June meeting, Mr. Leighton moved, "That in future the Annual Meeting be held on the fourth Friday in January."

Seconded by Mr Hopkinson.

Mr. Thirlwall moved as an amendment, "That the Annual Meeting be held on the last Friday in May."

The amendment having been seconded, was put from the chair and was declared to be lost.

The original motion was then put from the chair, and also declared to be negatived.

The Annual General Meeting then terminated, and the ordinary meeting was held.

The following donations to the Club were announced and the thanks of the meeting were given to their respective donors:—"Science Gossip," from the Publisher; "Popular Science Review," from the Publisher; "Scientific Opinion," from the Publisher; "Land and Water," from the Editor; "Transactions of the Manchester Literary and Philosophical Society," Vols. III. to VII., from the Society; "Micrographia," by Dr. Goring and Andrew Pritchard, from Mr. Thomas Russell; "Monthly Microscopical Journal," from the Publisher.

Mr. Bywater read a paper, by Mr. James J. Field, on the "Ratio-micro-polariscope," which was illustrated by a diagram, and the instrument was afterwards exhibited and explained by Mr. Field.

Ten gentlemen, proposed at the last meeting, were unanimously elected members of the Club.

The following gentlemen were proposed for membership:—Mr. G. C. Gowan, Mr. William Samuel Mavor, and Mr. W. Fell Woods.

The President announced the extra meetings and excursions during the ensuing month.

The meeting then terminated with the usual conversazione.

AUGUST 27TH, 1869.

DR. BRAITHWAITE, VICE-PRESIDENT, IN THE CHAIR,

A letter was read from the President, regretting his unavoidable absence from the meeting.

The minutes of the last meeting were read and approved.

The following donations to the Club were announced, and the thanks of the meeting given to their respective donors:—"Land and Water," from the Editor; three negatives of a glass tumbler, in illustration of the nature of diatom markings, and positives printed from same, together with the half tumbler from which they were done, from Mr. Bockett; a number of slides of Chelymorpha Phyllophora, from Messrs. F. Oxley and T. C. White; and three slides from Mr. Moginie.

Three gentlemen proposed at the last meeting were unanimously elected members of the club.

A paper on "Oysters and Oyster Spat," by Mr. G. W. Hart, one of Her Majesty's Inspectors of Oyster Fisheries, was read by the Secretary.

Mr Hislop read a paper on a "New Analysing Selenite Stage." (See page 225.)

Mr. J. Matthews read a paper on a "New and Simple Method of Micrometry." (See page 231.)

Mr. Hailes called attention to a new porcelain lamp shade, and laid specimens on the table for the examination of members.

Mr. Hislop exhibited a modification of the mercurial thermometer for registering the temperature at which micro-crystals are formed.

Mr. Hislop called attention to a new 3½in. object glass, made by Mr. Smith, junr.

The following gentlemen were proposed for membership;—Mr. J. D. Radcliff, Mr. William Matthews, Mr. Richard Epps, and Mr. William Ackland.

The Chairman then announced the extra meeting and the excursions for the ensuing month, and the proceedings terminated with the usual conversazione.

NOTES.

Spectroscopic Examination of the Diatomaceæ.

The vegetable nature of the Diatomaceæ is now generally admitted; but if any farther proof is needed, we have it in marked results from the application of the Spectroscope. I have been enabled to prove the absolute identity of *chlorophyl*, or the green endochrome of plants with *diatomin*, or the olive-brown endochrome of the Diatomaceæ. The spectrum-microscope is now too well known to need any description here. The one I have used was made by Browning, of London. It is not at all difficult to obtain a characteristic specimen from a living diatom, and to compare it directly with that of a desmid or other plant. I need not here give the results in detail. Suffice it that, from about fifty comparisons of spectra, I can unhesitatingly assert that the spectrum of chlorophyl is identical with that of diatomin. A very black, narrow band in the extreme red, reading at the lower edge, which appears to be constant, about $\frac{7}{8}$ of Mr Sorby's scale, is too characteristic to be mistaken. There are two other very faint bands, not easily seen, and somewhat more variable in position. The black band in the red is always present, and is remarkably constant in the position of its lower edge. In making comparisons of spectra, it is of the utmost importance that the slit of the spectroscope should be absolutely in the focus of the achromatic eye-lens. If this be not attended to, there will be a slight parallax; and bands really identical in position, *e.g.*, those of blood (scarlet cruorine) will not absolutely correspond where two spectra are formed;—one from blood on the stage of the microscope, and the other from the same on the stage of the eyepiece. The dark band of the chlorophyl-spectrum is slightly variable in width; and the action of acids and alkalies sometimes causes a slight displacement, the former raising (moving towards the blue end), and the latter depressing. The endochrome of a diatom after treatment with acid is green, and the acid, in this case, produces scarcely any displacement of the band, which may be observed in the dark reddish mass of the dead diatomaceæ, almost identical in colour with the ferrous carbonate so often found in bays where the large diatoms are abundant, and what is more remarkable is, that the carbonate gives no absorption bands at all. As a general rule, alcoholic solutions of chlorophyl and diatomin have the band slightly depressed, reading 1 to $1\frac{1}{2}$ on the interference scale.—Paper by H. L. Smith in *Silliman's American Journal*, July, 1869.

END OF VOL. I.

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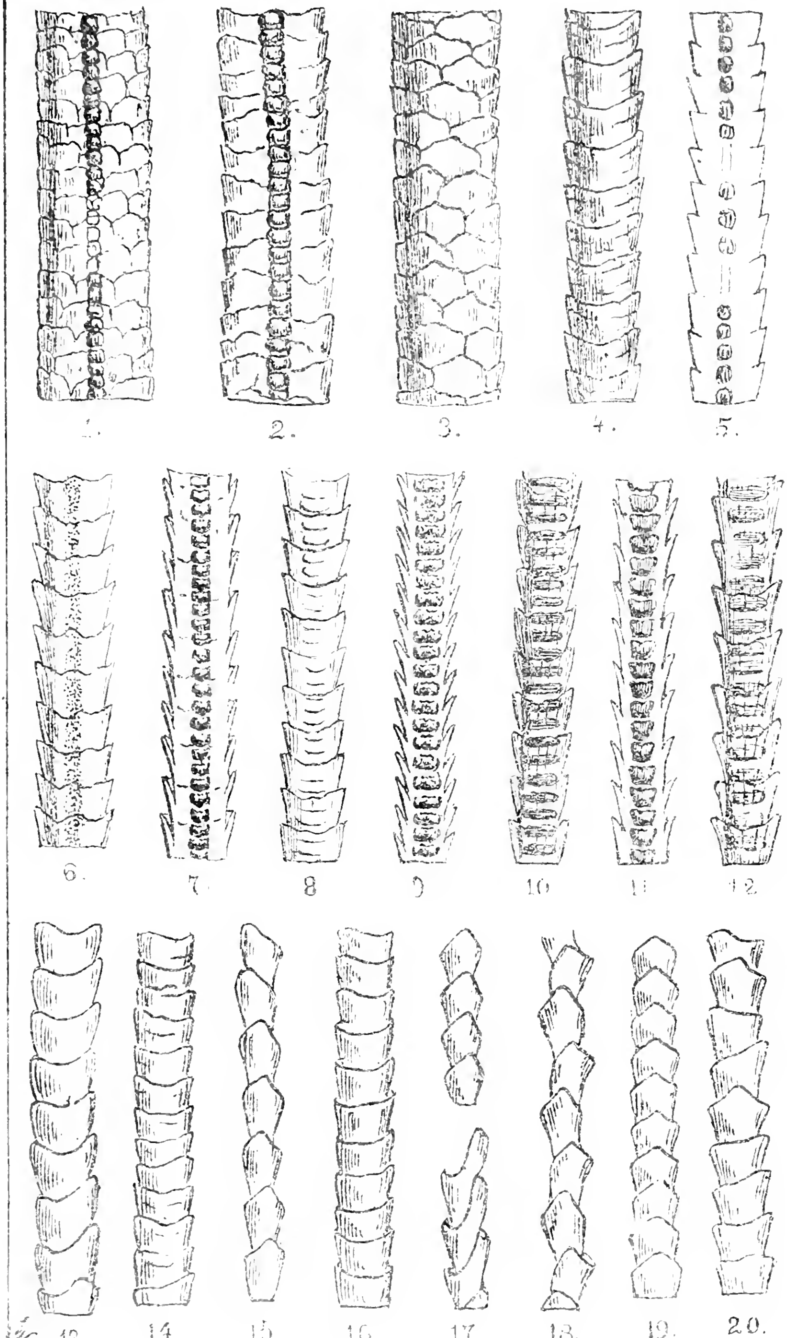

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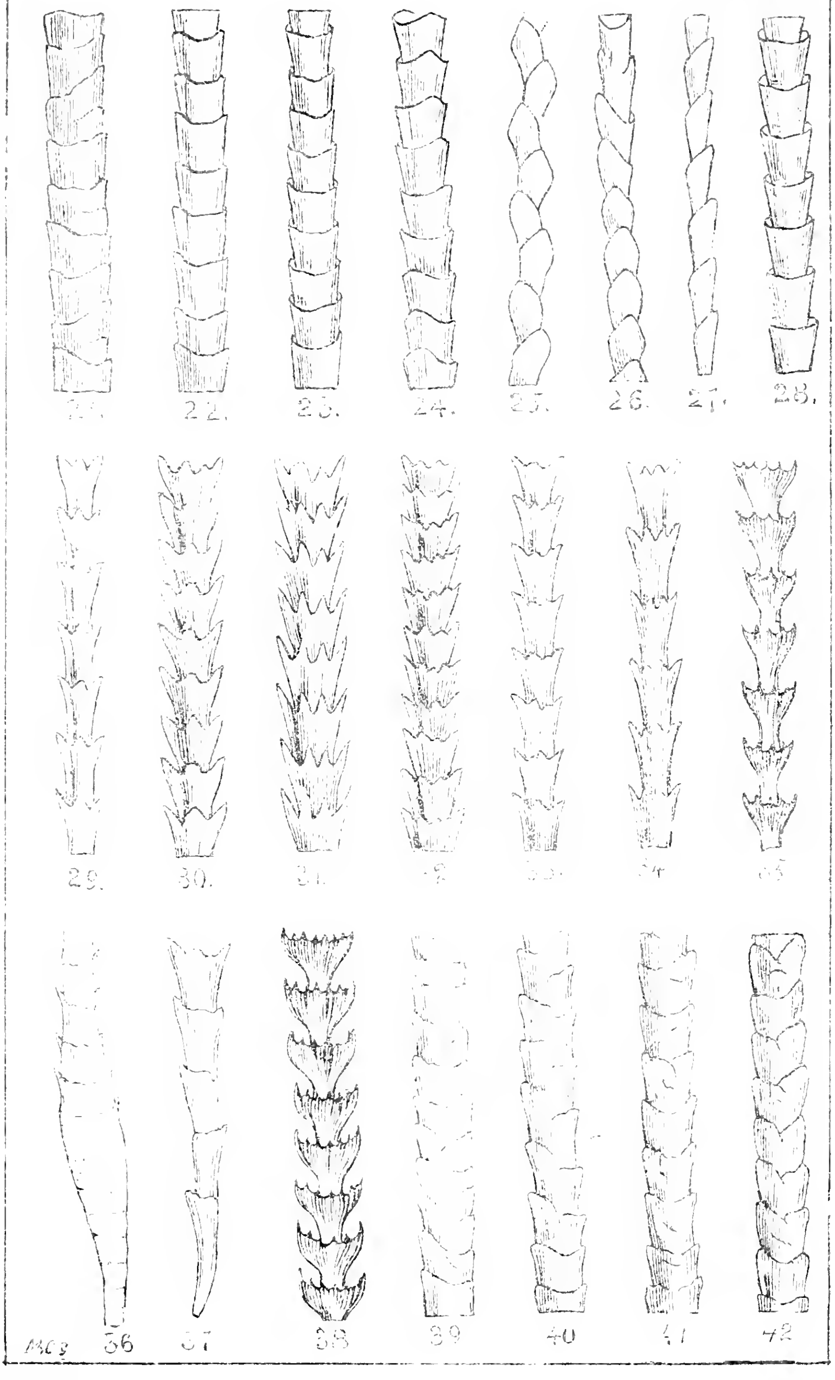

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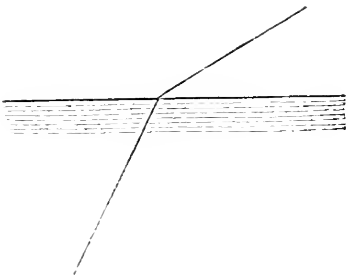

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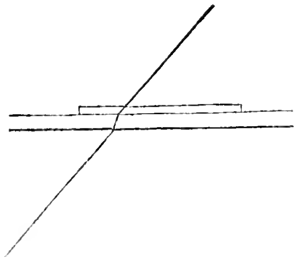

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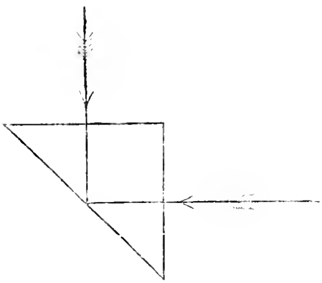

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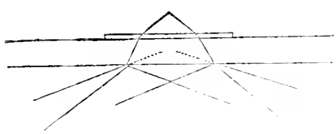

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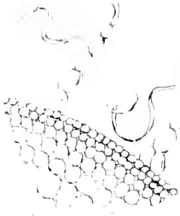

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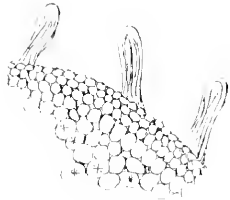

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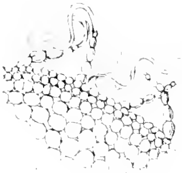

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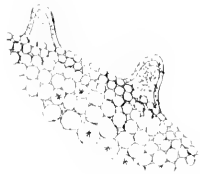

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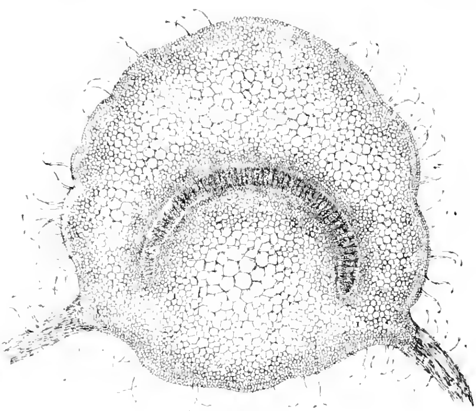

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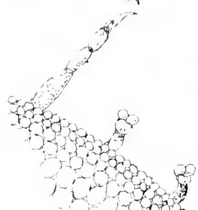

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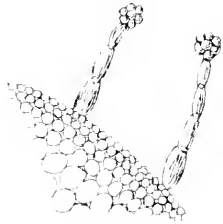

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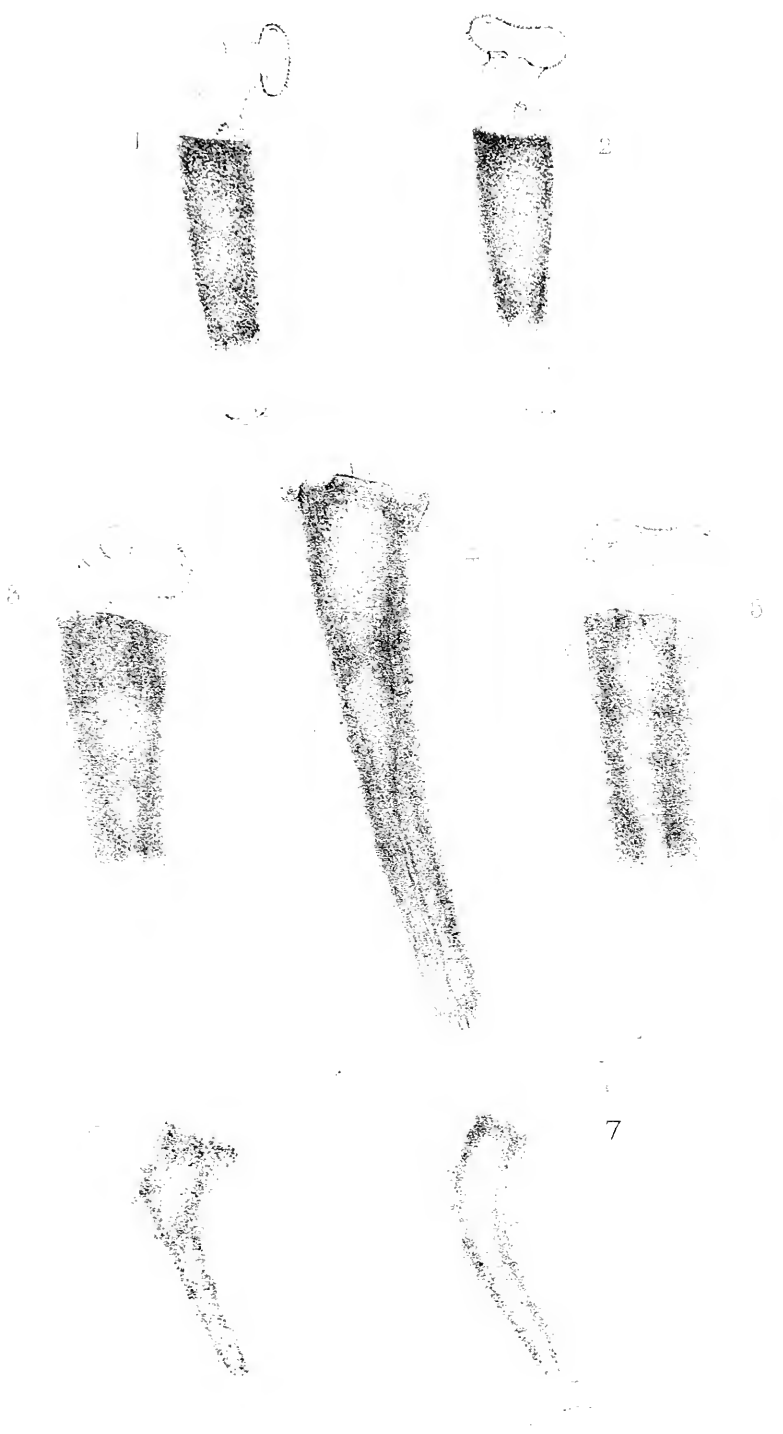

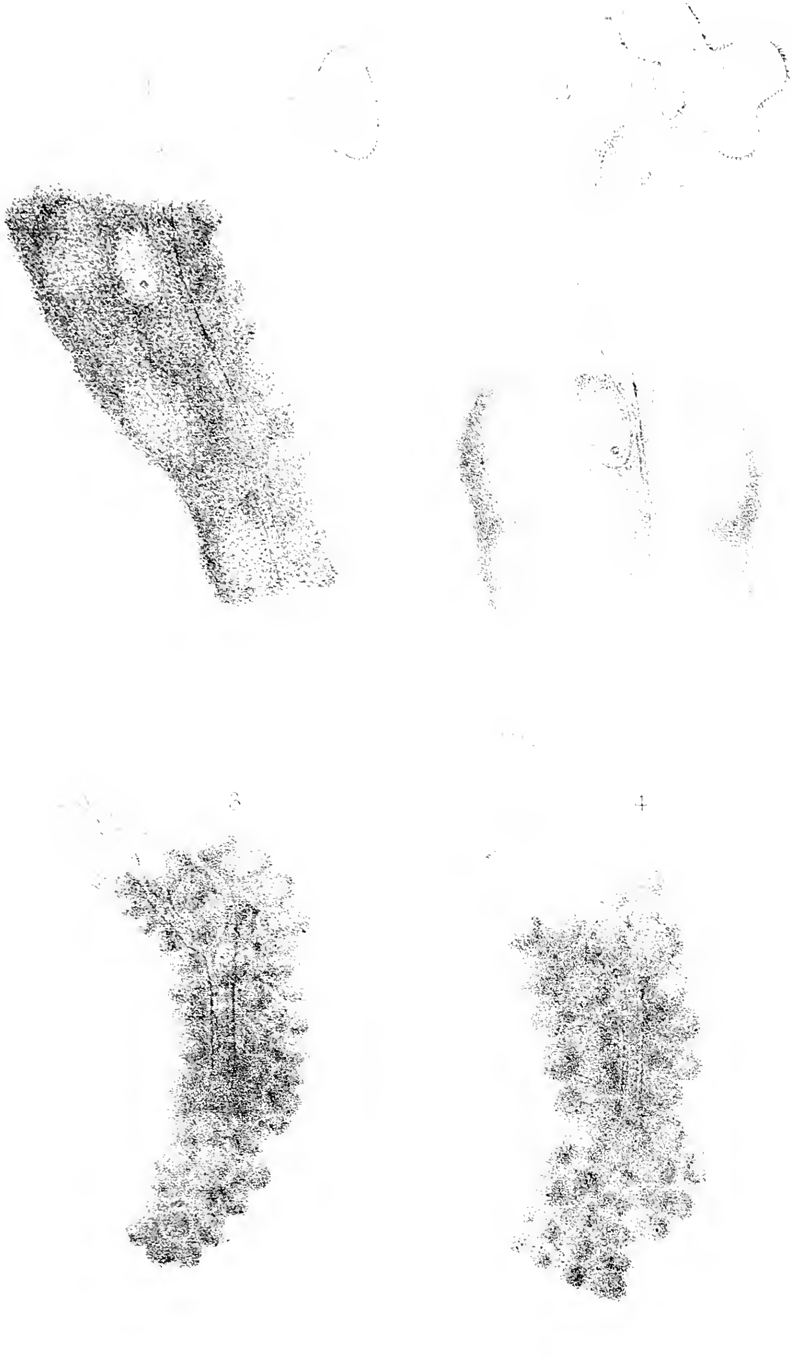

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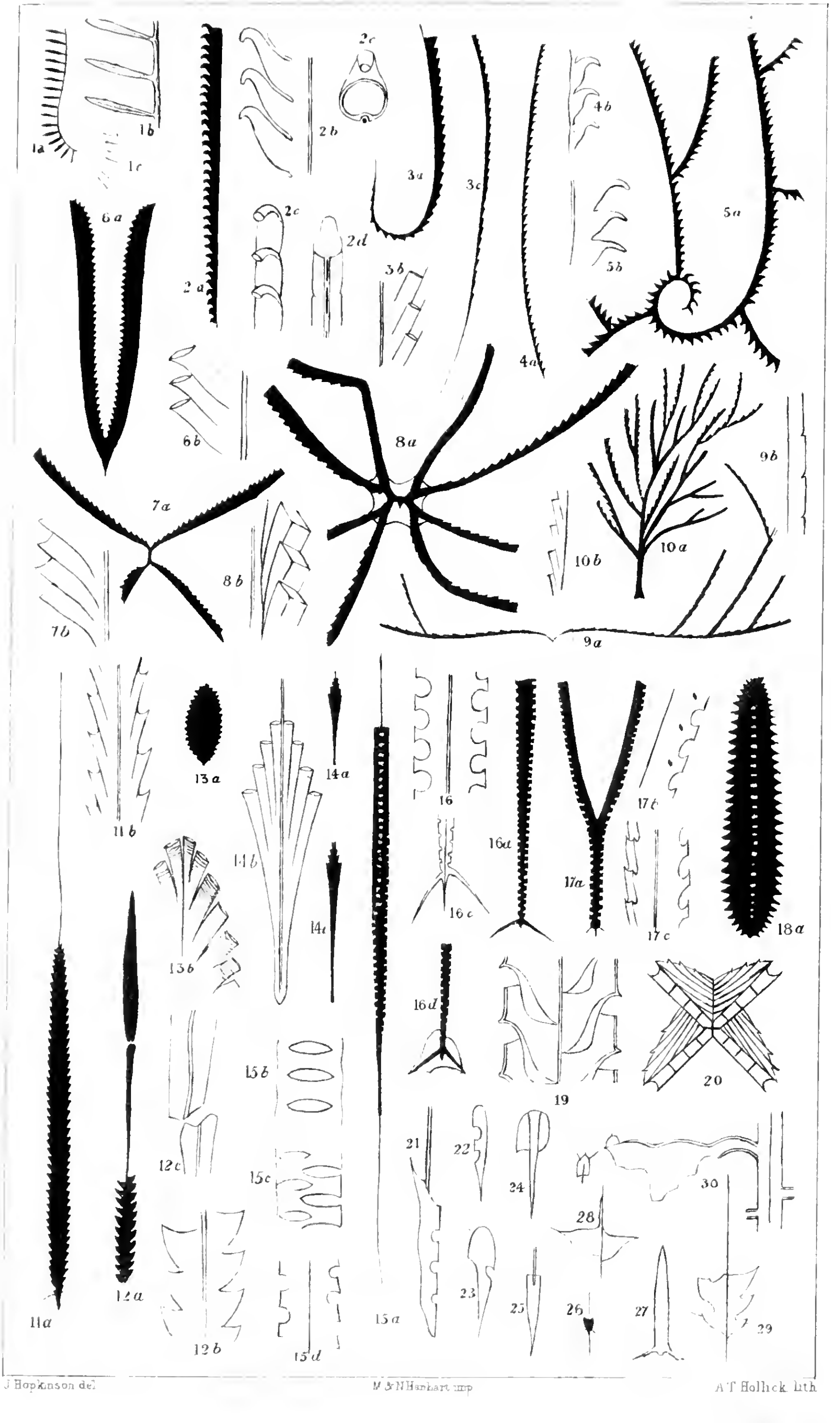

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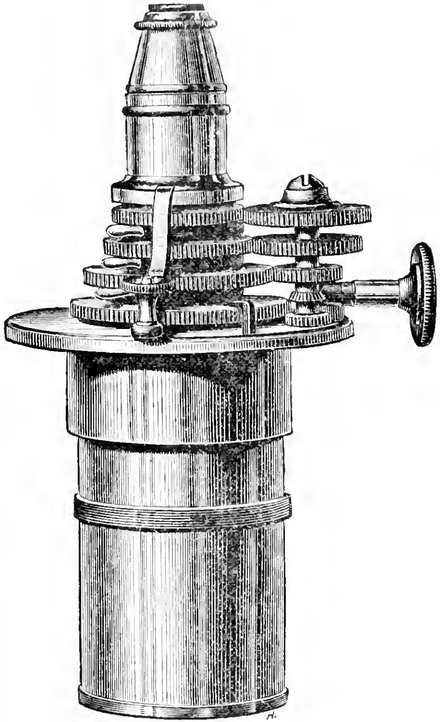

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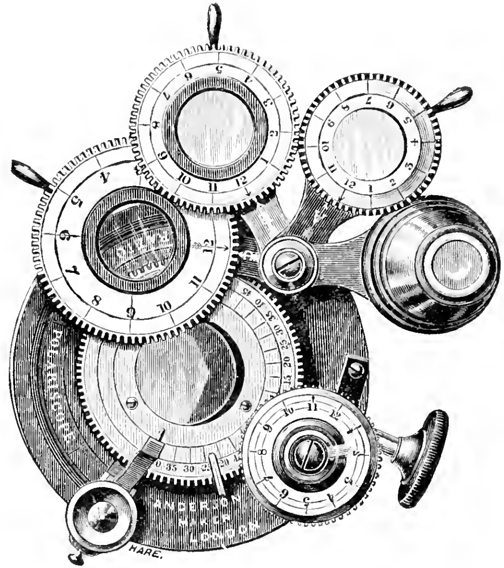

Fig 2.

FIELD'S RATIO-MICRO-POLARISCOPE.

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THIRD REPORT

OF THE

Quekett Microscopical Club,

AND

LIST OF MEMBERS.

MEETING AT UNIVERSITY COLLEGE, LONDON, ON THE FOURTH FRIDAY OF EVERY MONTH AT EIGHT O'CLOCK.

OFFICES: 192, PICCADILLY,

LONDON.

July 1868.

LONDON:

PRINTED BY W. DAVY AND SON, GILBERT STREET, W.

OFFICERS AND COMMITTEE.

(Elected July 1868.)

President.

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F. C. S. ROPER, F.L.S.

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Secretary.

WITHAM M. BYWATER.

Secretary for Foreign Correspondence.

M. C. COOKE.

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F. W. GAY.
W. J. GRAY, M.D.
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J. BOCKETT.
T. KETTERINGHAM.

Librarian.

EDWARD JAQUES.

Curator.

G. W. RUFFLE.

Reporter.

RICHARD T. LEWIS.

Excursion Committee.

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F. W. GAY.
W. W. REEVES.
W. T. SUFFOLK.

Exchange (of Slides) Committee.

J. BOCKETT.
H. F. HAILES.
W. HISLOP, F.R.A.S.
E. MARKS.

PAST PRESIDENTS.

	Elected.
EDWIN LANKESTER, M.D., F.R.S.	July, 1865
ERNEST HART	„ 1866

REPORT OF THE COMMITTEE.

YOUR Committee have much pleasure in reporting that the success of the Club continues to advance, and that the keen interest evinced by the members in previous years has by no means abated during the year now brought to a close.

The first among the many pleasing circumstances to which the Committee would desire to draw attention is that the Council of University College have most liberally renewed their permission to the Club to meet in this Library during another year. This is a privilege well calculated to encourage and promote the objects for which the Society was originally instituted. It therefore becomes a boon for which the Committee and members must be equally grateful.

After considerable deliberation your Committee succeeded in effecting such arrangements as have enabled them to commence the publication of a Quarterly Journal of Proceedings, and under the editorship of Mr. HISLOP two parts of the Journal of the Quekett Microscopical Club have already been issued. The Committee trust that the form in which the Journal has appeared and the matter it has

contained have been generally satisfactory to the members of the Club. It is hoped that the Journal may be the means of rendering absent members better acquainted with the proceedings of the Club, and so aid in promoting their co-operation in the cause of microscopical science.

The Committee cannot do otherwise than allude to the Soirée of the Club given in March last. They feel that the success of the evening, and the gratification afforded to the members and their friends, were greatly due to the exertions of those of our number who contributed specimens for exhibition, or in other ways aided in carrying out the general arrangements.

The many interesting papers read during the past year are now more or less fully recorded in the Journal. It is therefore unnecessary to enumerate them here.

The number of slides now in the Cabinet amount to 700, the following additions having been received during the year:—

Anonymous	14
Mr. J. A. Archer . . .	5
,, C. Collins	1
,, M. C. Cooke	250
,, T. Curties	2
Dr. Dempsey	12
Mr. W. H. Golding . . .	13
,, H. F. Hailes . .	5

Mr. W. Hislop	4
,, F. Kitton	3
,, R. T. Lewis	25
,, S. J. McIntire	26
,, J. Martin	3
,, J. Meacher	1
,, W. Moginie	1
,, G. Potter	5
,, T. Ross	20
Capt. St. John	1
Mr. T. Simpson	8
,, H. A. Smith	14
,, T. C. White	5
America	14
Germany	5
	437

By numerous donations and some purchases, various important additions have been made to the Books of Reference in the Library, whereby its capability of usefulness has been considerably extended.

Your Committee have pleasure in recording the increasing success of the Excursions, which form so exceedingly important a feature in the working of our Club It is hoped that the results which the Excursion Committee may be able to make known at the termination of the season will bring many interesting facts as to localities and habitats

prominently before us, and thus stimulate members to renewed exertions, and lead to more methodical records of observation in the future.

Your Committee have under consideration plans for affording members increased opportunities of meeting during the winter months for conversation, as well as for the exhibition of recent captures or other objects of interest. Such meetings are intended in some measure to supply the place of the Summer Excursions. Should the endeavours of the Committee to effect such an arrangement be successful, they have reason to believe the result will be most advantageous to the Club.

Since the last Annual Meeting 133 gentlemen have joined the Club, and during that period 24 names have been withdrawn; a few in consequence of death, and others by retirement. Consequently the total number of subscribing members on the 30th of June is 382.

The Committee cannot conclude their Report without expressing their thanks for the assistance so cheerfully rendered by Mr. JAQUES as Librarian and by Mr. RUFFLE as Curator. Their cordial thanks are also due to Mr. LEWIS for his valuable reports; to Messrs. ARNOLD, GAY, REEVES and SUFFOLK, the Excursion Committee; and to Messrs. BOCKETT, HAILES, HISLOP and MARKS, the Exchange Committee.

The Committee hope that the continued success of the

Club will promote increased activity among the members, and that by fostering a unanimity of feeling and a uniformity of action they will enlarge its sphere of usefulness and more fully develop the many advantages which it offers.

June 30*th*, 1868.

TREASURER'S REPORT,

JUNE 30TH, 1868.

RECEIPTS.	£	s.	d.
Balance in hand at last Audit	35	7	3
Subscriptions received from July 1, 1867, to June 30th, 1868	162	10	0
	£197	17	3

PAYMENTS.	£	s.	d.
Printing and Stationery	26	14	10
Postages	9	0	0
Advertisements	1	9	6
Attendants	2	12	6
Property purchased	19	5	1
Petty Expenses	11	0	8
Expenses of Soirée	39	7	6
Journal, Nos. I. and II.—nett cost ...	26	6	5
Balance at Banker's	62	0	9
	£197	17	3

ROBERT HARDWICKE, *Treasurer.*

We the undersigned having examined the above Statement of Income and Expenditure, and the Vouchers referring thereto, hereby certify that the said Account is correct.

W. T. SUFFOLK,
THOS. C. WHITE, } *Auditors.*

LIST OF MEMBERS.

Date of Election.	
Oct. 27, 1865	Aldous, W. Lens, 47 Liverpool-street, W.C.
Mar. 23, 1866	Allbon, W., F.R.M.S., 525 New Oxford-street, W.C.
Sept. 27, 1867	Allen, John T., 57 Cross-street, Islington, N.
Dec. 22, 1865	Andrew, F. W., 3 Neville-terrace, Fulham-road, S.W.
Sept. 22, 1865	Annett, James, Hampton, S.W.
July 7, 1865	Archer, J. A., 172 Strand, W.C.
Oct. 27, 1865	Arnold, W. J. de L., 6 Stamford-villas, Fulham, S.W.
Jan. 25, 1867	Arrow, James, Jun., 12 North-terrace, Clapham, S.W.
Aug. 28, 1868	Atkinson, C., Wingfields, Snaresbrook, N.E.
Dec. 22, 1865	Atkinson, John, 54 Brook-street, W.
Mar. 27, 1868	Aubert, Alfred, Lloyds, E.C.
May 22, 1868	Bailey, Capt. L. C., R.N., F.R.G.S., R.A.S., Topographical Dept., New-st., Spring-gardens, S.W.
July 26, 1867	Bailey, George H., M.R.C.S., 25 Charles-street, Middlesex Hospital, W.
Dec. 27, 1867	Bailey, John W., 162 Fenchurch-street, E.C.
April 24, 1868	Baker, Charles, F.R.M.S., 244 High Holborn, W.C.
July 27, 1866	Baker, St. Thomas, F.R.M.S., 184 King's-road, Chelsea, S.W.
Aug. 23, 1867	Bannister, Richard, F.R.M.S., The Laboratory, Somerset-house, W.C.
Jan. 26, 1866	Barber, John, F.R.M.S., 29 Brunswick-gardens, Campden-hill, W.
June 26, 1868	Barnard, J. C., 139 Newington-causeway, S.E.

Date of Election.	
Jan. 24, 1868	Barnes, Fancourt, 46 Finsbury-square, E.C.
Nov. 23, 1866	Barnes, Capt. E., York.
Oct. 27, 1865	Barratt, T. J., 91 Great Russell-street, W.C.
Oct. 26, 1866	Bastian, Charlton, M.D., M.A., M.B., F.R.M.S., St. Mary's Hospital, W.
Dec. 27, 1867	Bealey, Adam, M.D., 27 Tavistock-square, W.C.
Aug. 23, 1867	Beazley, Joseph, 10 The Terrace, Kennington-park, S.E.
Oct. 26, 1866	Beck, Joseph, F.R.M.S., 31 Cornhill, E.C.
Nov. 23, 1866	Becker, Chas., 21 Florence-street, Islington, N.
Nov. 23, 1866	Beigell, Hermann, M.D., 3 Finsbury-square, E.C.
Aug. 23, 1867	Bell, James, F.R.M.S., The Laboratory, Somerset-house, W.C.
Dec. 27, 1867	Bentley, C. S., 38 Dale-road, Kentish-town, N.W.
May 22, 1868	Berney, John, F.R.M.S., 61 North-end, Croydon.
Nov. 23, 1866	Betts, Arthur R., F.R.M.S., 1 St. John's-park-villas, Upper Holloway, N.
May 25, 1866	Bezant, W. F., F.R.M.S., 7 Whittington-terrace, Highgate-hill, N.
Mar. 27, 1868	Bidlake, J. P., F.R.M.S., 318 Essex-road, N.
Jan. 25, 1867	Bird, Peter Hinckes, M.D., 1 Norfolk-square, Hyde-park, W.
Oct. 26, 1866	Bithell, Richd., B.Sc., Ph.D., Acacia-cottage, London-road, Clapton, N.E.
Nov. 22, 1867	Blake, F. W., 5 Serle-street, Lincoln's-inn, W.C.
Feb. 23, 1866	Blake, T., 6 Charlotte-terrace, Brook-green, Hammersmith, W.
Jan. 24, 1868	Blandy, F. J., Reading.
July 7, 1865	Bockett, J., F.R.M.S., 10 Willingham-terrace, Leighton-road, Kentish-town, N.W.
April 24, 1868	Bodkin, W. P., Merton-lane, Highgate-rise, N.
Mar. 27, 1868	Bowing, John, 6 Bowater-crescent, Woolwich, S.E.
Dec. 22, 1865	Brain, T., Buckingham-house, Buckingham-road, De Beauvoir-town, N.
Oct. 27, 1865	Braithwaite, R., M.D., M.R.C.S.E., F.L.S., F.R.M.S. (*Vice-President*), 59 Vauxhall-walk, S.E.
Nov. 24, 1865	Breese, C. J., F.R.M.S., 157 Goswell-street, E.C.
June 26, 1868	Briggs, H. B., 36½ Upper Thames-street, E.C.
Mar. 22, 1867	Brightween, G., 8 Finch-lane, E.C.

Date of Election.	
Dec. 28, 1866	Brown, W., 203 Great Portland-street, W.
May 22, 1868	Brown, W. J., 20 Groombridge-road, South Hackney, N.E.
May 24, 1867	Browne, H., 40 Camden-square, N.W.
Oct. 26, 1866	Bruce, R., M.B., &c., 6 Albert-terrace, Regent's-park, N.W.
May 25, 1866	Buchanan, A., 11A Myddelton-square, E.C.
Sept. 28, 1866	Burgess, J. W., 329 Hackney-road, N.E.
Feb. 23, 1866	Burgess, N., 329 Hackney-road, N.E.
April 24, 1868	Burr, T. W., F.R.A.S., C.S., F.R.M.S., 14 Tibberton-square, N.
April 24, 1868	Burrows, John, Wanstead, N.E.
Mar. 27, 1868	Burrows, J. Nelson, The Grove, Wanstead, N.E.
June 14, 1865	Bywater, Witham M., F.R.M.S. (*Secretary*), 5 Hanover-square, W.
July 27, 1866	Bywater, W. M., Jun., 5 Hanover-square, W.
May 24, 1867	Callaghan, James, 12 Coal-yard, W.C.
Nov. 24, 1865	Callow, T., 8 Park-lane, Piccadilly, W.
Aug. 23, 1867	Cameron, James, The Laboratory, Somerset-house, W.C.
June 28, 1867	Chaplin, R. P., F.R.M.S., 29 Regent's-park-road, N.W.
Dec. 27, 1867	Chapman, W. C., 39 Granville-square, W.C.
Feb. 23, 1866	Chard, O. E. P., 13 Eccleston-street-south, Pimlico, S.W.
Oct. 25, 1867	Clabon, J. M., F.R.M.S., G.S., 4 St. George's-terrace, Regent's-park, N.W.
Dec. 22, 1865	Clarke, T. T., Swakeleys, near Uxbridge, Middlesex.
Mar. 22, 1867	Clover, Jos. T., 3 Cavendish-place, Cavendish-square, W.
May 22, 1868	Cocks, W. G., 18 Kent-villas, Grange-road-east, Dalston, N.E.
Feb. 22, 1867	Cogswell, Chas., M.D., 47 York-terrace, Regent's-park, N.W.
July 7, 1865	Cole, A., 9 Clyde-street, Redcliffe-gardens, West Brompton, S.W.

Date of Election.	
Jan. 25, 1867	Coles, Ferdinand, A.P.S., 248 King's-road, Chelsea, S.W.
July 7, 1865	Collins, C., F.R.M.S., 77 Great Titchfield-st., W.
Dec. 22, 1865	Collins, G., 31 Godolphin-road, Shepherd's-bush, W.
May 22, 1868	Collins, Jas., 11 Arthur-street, Deptford, S.E.
June 14, 1865	Cooke, M. C. (*Vice-President. Sect. for Foreign Correspondence*), 2 Junction-villas, Upper Holloway, N.
Feb. 22, 1867	Cooper, Frank W., L.R.C.S. Edin., Leytonstone, N.E.
Mar. 23, 1866	Coppock, C., F.R.M.S., 31 Cornhill, E.C.
Aug. 28, 1868	Cousens, John, Grove-road, Wanstead, N.E.
Aug. 4, 1865	Cresy, E., Metropolitan Board of Works, Spring-gardens, S.W.
Aug. 28, 1868	Crisp, Frank, 134, Adelaide-road, N.W.
Feb. 27, 1868	Crook, Thomas, F.R.M.S., Vine-villa, Weston-green, Kingston-on-Thames.
Oct. 26, 1866	Crookes, William, F.R.S., 20 Mornington-rd., N.W.
July 7, 1865	Crosbie, J. J., 11 Grange-road, Canonbury, N.
July 26, 1867	Cross, Robert, M.D., 21 New-street, Spring-gardens, S.W.
Sept. 28, 1866	Crouch, Hen., F.R.M.S., 54 London-wall, E.C.
Aug. 23, 1867	Crowther, James, 7 Tyrwhitt-road, Lewisham-road, S.E.
Mar. 27, 1868	Cubitt, Chas., F.R.M.S., 3 Great George-street, Westminster. S.W.
Nov. 23, 1866	Cumming, John, F.G.S., 7 Montague-place, Russell-square, W.C.
May 25, 1866	Curties, T., F.R.M.S., 244 High Holborn, W.C.
April 27, 1866	Davis, S., 11 Priory-road, South Lambeth, S.W.
Sept. 28, 1866	Dawson, George, M.A., King's-college, W.C.
May 25, 1866	Dawson, J. E., F.R.M.S., The Woodridings, Pinner, Middlesex.
May 22, 1868	Dean, G. A. H., Elmwood, Catford-bridge, Kent, S.E.
Feb. 27, 1868	Dempsey, Joseph M., M.D., F.R.M.S. (*Vice-President*), 27 Charterhouse-square, E.C.

Date of Election.

Date of Election	
Jan. 26, 1866	Denman, J. L., F.R.M.S., 27 Kensington-gardens-square, Hyde-park, W.
June 26, 1868	Dickens, Charles, Stanstead-park, Forest-hill, S.E.
Dec. 22, 1865	Dix, James, 26 Pentonville-road, N.
Sept. 22, 1865	Dixon, E. A., 14 Dalston-terrace, N.E.
Nov. 24, 1865	Dobson, H. H., F.R.M.S., 19 Brompton-square, S.W.
Jan. 25, 1867	Dodd, Josiah E., 11 Margaret-street, Cavendish-square, W.
Aug. 28, 1868	Donaldson, Alexander L., 44 George-street, Portman-square, W,
Dec. 27, 1867	Draper, E. T., F.R.M.S., Harringay-park, Hornsey, N.
May 22, 1868	Dresser, W. G., 68 Westbourne-road-north, Barnsbury, N.
Sept. 22, 1865	DURHAM, ARTHUR E., F.L.S., F.R.M.S. (*President*), 82 Brook-street, W.
Nov. 23, 1866	Durham, Fredk., 14 St. Thomas-street, Boro', S.E.
Aug. 28, 1868	Duer, Y., Cleygate, near Esher, Surrey.
Aug. 28, 1868	Eddy, James Ray, Carleton-grange, Skipton, Yorkshire.
June 28, 1867	Edmonds, R., 176 Mary's-road, Plumstead, S.E.
July 26, 1867	Eldridge, John R., 20 Downshire-hill, Hampstead, N.W.
July 27, 1865	Emery, J. J., 99 St. George's-road, Southwark, S.E.
Nov. 23, 1866	Fawn, George, 125 Stanley-street, Pimlico, S.W.
Mar. 22, 1867	Fearns, Francis H., Westmoreland-house, Walworth-common, S.E.
Mar. 27, 1868	Field, James, High-street, Highgate, N.
July 26, 1867	Fitch, Fredk., F.R.M.S., Hadleigh-house, Highbury New-park, N.
May 22, 1868	Ford, W. B., 107 St. John-street-road, E.C.
Aug. 4, 1865	Foster, P. Le Neve, M.A., Society of Arts, Adelphi, W.C.

Date of Election.	
Aug. 24, 1866	Foster, Percival, F.L.S., Belsize-lane, Hampstead, N.W.
Dec. 28, 1866	Fox, C. J., F.R.M.S., 16 Cork-street, Bond-st., W.
Mar. 27, 1868	Fox, John James, Devizes.
Dec. 22, 1865	Fox, Tilbury, M.D., M.R.C.P., 43 Sackville-street, Piccadilly, W.
May 25, 1866	Freeman, W., 2 Ravensbourne-hill, Greenwich, S.E.
June 26, 1868	Fry, Rev. James, M.A,, F.R.M.S., Monson-villa, Redhill, Surrey.
May 22, 1868	Fryer, G. H., F.R.M.S., 13 West Abbey-road, St. John's-wood, N.W.
Oct. 25, 1867	Furlonge, W. H., 20 Mark-lane, E.C.
May 25, 1866	Gardiner, G., 244 High Holborn, W.C.
April 24, 1868	Garnham, John, F.R.M.S., 123 Bunhill-row, E.C.
July 7, 1865	Gay, F. W., F.R.M.S., 113 High Holborn, W.C.
Sept. 22, 1865	Geddes, P., Millbank, Westminster, S.W.
July 26, 1867	George, Edward, F.R.M.S., 12 Derby villas, Forest-hill, S.E.
Mar. 22, 1867	George, Henry, 65 Castle-street, Oxford-market, W.
June 14, 1865	Gibson, W., 9 Lupus-street, Pimlico, S.W.
Aug. 23, 1867	Gilbert, C. H. D., 65 Ludgate-hill, E.C.
July 27, 1866	Gill, Edmund, F.R.M.S., 18 Doughty-street, Mecklenburg-square, W.C.
Nov. 23, 1866	Gill, F. W., Bedford-villas, Croydon.
Nov. 24, 1865	Goddard, D. E., F.R.M.S., 5 York-villas, Stanstead-lane, Forest-hill, S.E.
Nov. 22, 1867	Golding, W. H., 73 Mark-lane, E.C.
Oct. 26, 1866	Gooch, James W., 23 High-street, Eton.
Dec. 22, 1865	Goode, W., 127 St. George's-square, Pimlico, S.W.
Dec. 28, 1866	Goss, S. D., M.D., F.R.G.S., 24 Newington-place, Kennington-park, S.E.
Feb. 22, 1867	Gostling, W., Edgecumbe-villa, Upper Tooting, S.W.
Mar. 27, 1868	Gray, S. Octavus, 1 St. George's-terrace, Dalston-rise, N.E.
Dec. 22, 1865	Gray, W. J., M.D., F.R.M.S., 41 Queen Anne-street, Cavendish-square, W.

Date of Election.	
May 25, 1866	Griffiths, A. W., 41 Clerkenwell-green, E.C.
July 24, 1868	Groves, J. W., 25 Charlotte-street, Bedford-square, W.C.
July 24, 1868	Grubbe, E. W., C.E., 49 Queen's-gardens, Hyde-park, W.
June 14, 1865	Hailes, H. F., 49 Offord-road, Barnsbury, N.
Aug. 23, 1867	Hainworth, John, 138 Camden-road, N.W.
Feb. 23, 1866	Hainworth, W., 7 York-terrace, Queen's-road, Peckham, S.E.
Dec. 28, 1866	Hallett, R. J., Hawthorn-cottage, Kilburn, N.W.
Oct. 26, 1866	Halley, Alexander, M.D., 7 Harley-street, W.
Dec. 22, 1865	Hancock, John C., 7 Grantham-place, Coburg-road, Old Kent-road, S.E.
June 14, 1865	Hardwicke, Robert, F.L.S. (*Treasurer*), 192 Piccadilly, W.
Sept. 28, 1866	Harkness, W., F.R.M.S., Laboratory, Somerset-house, W.C.
May 22, 1868	Harris, W. H., F.C.S., Buckley Wharf, Northamptonshire.
Aug. 24. 1866	HART, ERNEST, 69 Wimpole-street, W.
Oct. 26, 1866	Hart, G. W., Mengeham-house, Hayling, Havant.
Aug. 23, 1867	Harvey, William, 2 Lloyd-street, Lloyd-sq., W.C.
June 26, 1868	Haward, Alfred, Shirley-villas, Croydon.
June 28, 1867	Hawksley, Thos. P., 5 Windermere-road, Upper Holloway, N.
Mar. 23, 1866	Hazard, H., 455 New Cross-road, S.E.
Aug. 28, 1868	Heawood, Francis R. H., 80 Mark-lane, E.C.
Jan. 25, 1867	Heisch, Charles, F.R.M.S., 69 Jermyn-street, St. James's, S.W.
Aug. 23, 1867	Helm, Henry J., F.R.M.S., The Laboratory, Somerset-house, W.C.
June 26, 1868	Henry, A. H., 49 Queen's-gardens, Hyde-park, W.
May 22, 1868	Hewitt, B. A., 9 Percy-villas, Upper Norwood, S.E.
May 22, 1868	Hicks, J. J., 8 Hatton-garden, E.C.
Nov. 24, 1865	Hide, T. C., 46 Fenchurch-street, E.C.
June 14, 1865	Highley, S., F.G.S., 10A Great Portland-street, W.
May 22, 1868	Hill, W. T., 122 St. John-street-road, E.C.

Date of Election.	
Sept. 28, 1866	Hind, F. H. P., 4 Pall-mall-east, S.W.
Nov. 23, 1866	Hinton, James, 18 Savile-row, W.
Aug. 4, 1865	Hislop, W., F.R.A.S., 177 St. John-street-road, Clerkenwell, E.C.
Oct. 26, 1866	Holdernesse, W. B., 12 Park-street, Windsor.
May 22, 1868	Holdsworth, Joseph, 54 Lombard-street, E.C.
Mar. 22, 1867	Holmes, Samuel, 180 High Holborn, W.C.
July 24, 1868	Holmes, W., M.R.C.S., 1 Brighton-villas, Lower Norwood, S.E.
April 24, 1868	Holmes, W. M., 338 Oxford-street, W.
April 27, 1866	Holtzapffel, J., A.I.C.E., 5 Great Coram-st., W.C.
April 26, 1867	Hooton, C., 3 Horningston-villas, Junction-rd., N.
May 22, 1868	Hopkinson, J., F.R.M.S., 8 Lawn-road, Haverstock-hill, N.W.
Oct. 26, 1866	Horncastle, H., Edwinstowe, near Ollerton, Notts.
April 26, 1867	Hovenden, F., 93 City-road, E.C.
Mar. 27, 1868	How, James, F.R.M.S., 2 Foster-lane, E.C.
Oct. 27, 1865	Hugman, W., Jun., 55 Guildford-street, Russell-square, W.C.
Dec. 28, 1866	Hunt, W. H. B., F.R.M.S., 23 Eversholt-street, Oakley-square, N.W.
May 24, 1867	Hutchinson, F., M.D., 29 Woburn-place, Russell-square, W.C.
May 24, 1867	Ingpen, John E., F.R.M.S., 7 Putney-hill, S.W.
Nov. 24, 1865	Irvine, J., 28 Upper Manor-street, Chelsea, S.W.
July 24, 1868	Jackson, F. R., Maple-villa, West Dulwich, S.E.
June 14, 1865	Jaques, Edward, F.R.M.S., Woods and Forests Office, Whitehall, S.W.
June 26, 1868	Jeakes, Lt.-Colonel, Winchester Hall, Highgate, N.
July 24, 1868	Jennings, Rev. Nathaniel, B.A., Hampden-house, Avenue-road, N.W.
Jan. 24, 1868	Jewell, C. C., 2 Great Queen-street, W.C.
Mar. 23, 1866	Jobson, T. C. W., 52 King-square, Goswell-road, E.C.

Date of Election.	
Jan. 24, 1868	Johnson, Rev. Andrew, M.A., Grammar School, Horselydown, S.E.
Mar. 23, 1866	Johnson, E. D., F.R.A.S., 9 Wilmington-sq. W.C.
Jan. 25, 1867	Johnson, John A., Wellington-road, Stoke Newington, N.
Jan. 26, 1866	Johnson, R. G., Horbury-villa, Ladbroke-square, Notting-hill, W.
July 26, 1867	Johnson, R. H., 7 Wellington-terrace, New-road, Hammersmith, W.
Dec. 22, 1865	Jones, Chas., Devonshire - villa, Windsor - road, Ealing, W.
Oct. 26, 1866	Kemp, Robert, 25 Junction-road, Upper Holloway, N.
Oct. 26, 1866	Kent, W. S., F.R.M.S., 56 Queen's-road, Notting-hill, W.
June 14, 1865	Ketteringham, T., 192 Piccadilly, W.
Aug. 23, 1867	Kiddle, Edward, The War Office, Pall-mall, S.W.
July 7, 1865	King, G. H., 190 Great Portland-street, W.
Jan. 24, 1868	King, W. W., South-grove-west, Mildmay-park, N.
April 26, 1867	Kirk, Joseph, 11 Blossom-st., Norton Folgate, N.E.
Jan. 24, 1868	Kirkby, W. H., 18 Old Broad-street, E.C.
July 27, 1866	Lambert, T. J., 151 Highbury New-park, N.
Nov. 23, 1866	Lambert, W., 4 New Basinghall-street, E.C.
Aug. 24, 1866	Lampray, John, F.R.G.S., F.A.S.L., F.R.M.S., 16 Camden-square, N.W.
Mar. 22, 1867	Lancaster, Thos., Bownham-house, Stroud, Gloucestershire.
Jan. 25, 1867	Lang, H., M.D., 41 Berners-street, W.
Oct. 26, 1866	Lang, Henry, 41 Berners-street, W.
Dec. 28, 1866	Langrish, H., 250 Pentonville-road, N.
Aug. 4, 1865	LANKESTER, EDWIN, M.D., F.R.S., F.L.S., F.R.M.S., Melton House, Child's-hill, Hampstead, N.W.
Aug. 28, 1868	Leaf, Charles J., F.L.S., F.R.M.S., &c. (*President of the Old Change Microscopical Society*), Old Change, E.C.

Date of Election.	
Aug. 24, 1866	Leakey, J. W., 3 Prince of Wales-avenue, Malden-road, N.W.
Feb. 27, 1868	Leefe, F. E., 289 Goswell-street, E.C.
Oct. 25, 1867	Leifchild, J. R., 42 Fitzroy-street, Fitzroy-sq., W.
Sept. 22, 1865	Leighton, W. H., 2 Merton-place, Chiswick, W.
Mar. 22, 1867	Lewinsky, John, 13 Frith-street, Soho, W.
Sept. 28, 1866	Lewis, H. W., 3 Medina-cottages, Seven Sisters-road, N.
April 27, 1866	Lewis, R. T., F.R.M.S., 1 Lowndes-terrace, Knightsbridge, S.W.
June 26, 1868	Lindley, W., Jun., Kidbrook-terrace, Blackheath, S.E.
Nov. 24, 1865	Loam, Michael, Hampton, Middlesex, S.W.
Jan. 26, 1866	Lord, John K., F.Z.S., Elm-house, Denmark-hill, S.E.
July 7, 1865	Loveday, J., 5 Clarence-terrace, Seven Sisters-road, N.
Nov. 24, 1865	Lovibond, J. W., F.R.M.S., 4 Blue-stile, Greenwich-road, S.E.
Sept. 22, 1865	Lovick, T., Board of Works, Spring-gardens, S.W.
April 27, 1866	Loy, W. T., Dingwall-road, Croydon.
Jan. 24, 1868	Macdonald, John, M.D., 68 Upper Kennington-lane, S.E.
Nov. 23, 1866	McIntire, S. J., F.R.M.S., 22 Bessborough-gardens, S.W.
Oct. 25, 1867	McLeod, R. G., 38 Little Queen-street, W.C.
May 22, 1868	McVean, W., 18 Wood-street, E.C.
June 14, 1865	Marks, E., 92 Southampton-road, Bloomsbury, W.C.
Nov. 23, 1866	Marriott, Allan, 10 Yonge-park, Seven Sisters-road, N.
Dec. 28, 1866	Marsh, W. A., 325 Hackney-road, N.E.
June 26, 1868	Martin, James, 110 Regent-street, W.
Dec. 27, 1867	Martinelli, A., 106 Albany-street, N.W.
Oct. 25, 1867	Marwood, W. G. H., 68 Downham-road, Kingsland, N.
Dec. 22, 1865	Mason, J., Hampton, Middlesex, S.W.

Date of Election.	
April 26, 1867	Matthews, G. K., St. John's-lodge, Beckenham, Kent, S.E.
Oct. 26, 1866	Matthews, John, M.D., 4 Mylne-street, Myddelton-square, E.C.
June 28, 1867	Matthews, Peter, L.D.S., F.Z.S., F.R.M.S., 17 Lower Berkeley-street, W.
July 7, 1865	May, W. R., 20 Trinidad-place, Islington, N.
Mar. 22, 1867	Meacher, John W., 76 Oakley-square, N.W.
June 26, 1868	Milledge, Alfred, 4 Upper Winchester-road, Stanstead-road, Forest-hill, S.E.
Sept. 28, 1866	Miller, Benj., F.R.M.S., 49 Maddox-street, Bond-street, W.
July 7, 1865	Millett, F. W., 15 Alfred-street, River-terrace, N.
May 25, 1866	Moginie, W., F.R.M.S., 35 Queen-square, W.C.
Mar. 27, 1868	Moore, Daniel, M.D., High-street, Hastings.
Oct. 26, 1866	Moore, S. W., St. Thomas's Hospital, S.E.
Oct. 27, 1865	Morrieson, Colonel R., F.R.M.S., Oriental Club, Hanover-square, W.
Mar. 27, 1868	Morris, J. W., F.L.S. (*President of the Bath Microscopical Society*), 16 Belmont, Bath.
July 26, 1867	Mott, H. H., 47 Union-grove, Clapham, S.W.
April 24, 1868	Mummery, J. Rigden, F.L.S., F.R.M.S., 10 Cavendish-place, W.
April 24, 1868	Mummery, J. Howard, 10 Cavendish-place, W.
Jan. 25, 1867	Murray, R. C., 69 Jermyn-street, St. James's, S.W.
Sept. 27, 1867	Nash, Thompson, 101 Mortimer-road, De Beauvoir-square, N.
Mar. 23, 1866	Nation, W. J., 30 King-square, Goswell-road, E.C.
Jan. 26, 1866	Newman, W., 5 Oval-road, Kennington, S.E.
July 7, 1865	Nicholson, D., 51 St. Paul's-churchyard, E.C.
April 26, 1867	Norman, John, Jun., 178 City-road, E.C.
Nov. 23, 1866	Norton, Arthur, St. Mary's Hospital, W.
Dec. 22, 1865	Nunn, C. G., Hampton, Middlesex, S.W.
April 26, 1867	Oakley, J. J., F.R.M.S., 183 Piccadilly, W.
Mar. 27, 1868	Oakeshott, John, High-street, Highgate, N.

Date of Election.	
Dec. 27, 1867	Osborn, C. E., 28 Albert-road, St. John's-ville, Highgate, N.
Dec. 27, 1867	Oxley, F., 60 Hungerford-road, Islington, N.
April 27, 1866	Parsons, S., M.D., 10 Grafton-street, Bond-st., W.
May 24, 1867	Pearce, G. T., 4 Bedford-row, Clapham-rise, S.W.
May 22, 1868	Pearsall, J. S., 38 Denbigh-street, Pimlico, S.W.
May 24, 1867	Pearson, John, 87 Edgware-road, W.
Oct. 25, 1867	Peppin, S. H., 25 Princes-street, Leicester-sq., W.
Oct. 27, 1865	Pickard, Joseph F., 32½ Colonnade, Russell-sq., W.C.
Feb. 22, 1867	Pollock, Timothy, M.D., F.R.C.S., 26 Hatton-garden, E.C.
Nov. 23, 1866	Potter, G., F.R.M.S., 7 Montpelier-road, Upper Holloway, N.
June 22, 1866	Powe, I., St. John's, Richmond, Surrey.
May 25, 1866	Powell, Hugh, F.R.M.S., 170 Euston-road, N.W.
July 7, 1865	Powell, Thomas, 18 Doughty-street, Mecklenburg-square, W.C.
Oct. 26, 1866	Praill, Edward, 39 Mornington-road, N.W.
Dec. 27, 1867	Preston, H. B., 1 Devonshire-road, Liverpool.
Jan. 26, 1866	Price, D. S., Ph.D., F.C.S., 26 Great George-street, Westminster, S.W.
July 26, 1867	Pritchett, F., 131 Fenchurch-street, E.C.
Feb. 23, 1866	Quick, George Edward, 109 Long-lane, Bermondsey, S.E.
Oct. 26, 1866	Rabbits, W. T., Selwood, Mayow-road, Forest-hill, S.E.
Nov. 23, 1866	Radermacher, J. J., 21 Tregunter-road, Boltons, West Brompton, S.W.
Oct. 26, 1866	Ramsbotham, J. M., M.D., 15 Amwell-street, Pentonville, E.C.
Oct. 26, 1866	Ramsden, Hildebrand, M.A., F.R.M.S., Forest-rise, Walthamstow, N.E.
Aug. 28, 1868	Rance, T. G., Widmore-lane, Bromley, Kent.

Date of Election.	
May 22, 1868	Rawles, W., 64 Kentish-town-road, N.W.
July 7, 1865	Reeves, W. W., F.R.M.S., 27 Church-terrace, Blackheath-hill, Greenwich, S.E.
April 24, 1868	Reynolds, John, 23 Chadwell-street, Pentonville, E.C.
Jan. 24, 1868	Ricca, Alexis, 2 Great St. Helens, E.C.
Jan. 24, 1868	Richardson, Charles J., 44 Duncan-terrace, Islington, N.
Dec. 22, 1865	Richardson, C. T., M.D., Warcop, near Penrith.
Oct. 25, 1867	Riddell, W., 2 Stowe-villas, Philip-lane, Tottenham, N.
Feb. 23, 1866	Rixon, F., F.R.M.S., Loats-road, Clapham-park, S.W.
Feb. 22, 1867	Roberts, Samuel, M.A., 9 Stratford-place, Camden-town, N.W.
May 24, 1867	Robey, James, F.R.M.S., Newcastle, Staffordshire.
May 22, 1868	Rogers, John, 14 Bramah-road, Brixton, S.W.
Oct. 26, 1866	Rogers, Jos. R., 12 Bellefield-terrace, Bellefields-road, Stockwell, S.W.
Oct. 26, 1866	Rogers, Thos., Mortlock-house, Loughborough-road, Brixton, S.W.
April 24, 1868	Rogerson, John, F.R.M.S., Worsley-villa, Ventnor, Isle of Wight.
May 22, 1868	Roper, F. C. S., F.L.S., F.G.S., F.R.M.S. (*Vice-President*), 157 Maida-vale, W.
Sept. 28, 1866	Ross, Thomas, F.R.M.S., 53 Wigmore-street, W.
July 24, 1868	Rowe, James, Jun., M.R.C.V.S., 65 High-street, Marylebone, W.
Oct. 26, 1866	Rowlett, John, 8 Regent-street, S.E.
June 14, 1865	Ruffle, G. W., 380 New Cross-road, S.E.
Mar. 22, 1866	Russell, Rev. F. W., F.R.M.S., Charing Cross Hospital, W.C.
Oct. 27, 1865	Russell, James, 4 Lansdowne-terrace, London-fields, Hackney, N.E.
Oct. 26, 1866	Russell, Joseph, F.R.M.S., Cumberland-lodge, Brixton-hill, S.W.
May 22, 1868	Russell, Thomas, 26 Westbourne-villas, W.
Feb. 22, 1867	Rutter, H. Lee, 2 Clifton-villas, Lansdown-circus, South Lambeth, S.W.

Date of Election.	
Nov. 22, 1867	St. John, Capt. Robert, 18 St. Aubyn's-road, Upper Norwood, S.E.
Nov. 22, 1867	Sanford, John, 30 Willes-road, Kentish-town, N.W.
April 26, 1867	Scadding, H., 9 New Turnstile, Holborn, W.C.
May 22, 1867	Scatliff, John Parr, M.D., 132 Sloane-street, S.W.
May 25, 1866	Sedgwick, L. W., M.D., 8 Cleveland-terrace, Hyde-park, W.
July 27, 1868	Sewell, Richard, Princes-road, Lambeth, S.E.
July 27, 1866	Sharpey, W., M.D., F.R.S., 33 Woburn-pl., W.C.
May 24, 1867	Shave, W., 38 Sidmouth-street, Regent's-sq., W.C.
Aug. 23, 1867	Simmons, James J., L.D.S., F.R.M.S., 18 Burton-crescent, W.C.
Dec. 27, 1867	Simons, Henry, Northumberland-house, Green-lanes, Stoke Newington, N.
May 25, 1866	Simpson, Rev. D., F.R.M.S., 6 Henrietta-street, Brunswick-square, W.C.
Dec. 28, 1866	Simpson, J. Wharton, 36 Canonbury-pk. South, N.
Mar. 27, 1868	Simson, Thos., St. John's-villa, Upper Lewisham-road, S.E.
Dec. 28, 1866	Slade, J., 103 St. John-street-road, E.C.
May 25, 1866	Smith, Alpheus, 2 Hanover-place, Rye-lane, Peckham, S.E.
May 25, 1866	Smith, Charles E., Stanmore-villa, Beulah-hill, Upper Norwood, S.E.
Dec. 27, 1867	Smith, George J., 112 Packington-st., Islington, N.
Oct. 26, 1866	Smith, H. Ambrose, 5 Lothbury, E.C.
June 26, 1868	Smith, James, F.L.S., F.R.M.S., 5 Willow-cottages, Canonbury, N.
May 22, 1868	Smith, James John, F.R.M.S., 56 Tollington-rd. N.
July 7, 1865	Smith, Jos., 83 Cambridge-terrace, Pimlico, S.W.
April 24, 1868	Snellgrove, W., 22 Surrey-square, S.E.
Sept. 22, 1865	Southwell, C., 44 Princes-street, Soho, W.
May 22, 1868	Spencer, John, White-house, Croydon.
Dec. 28, 1866	Spicer, Rev. W. W., F.R.M.S., 17 Brighton-park, Clifton, Bristol.
Nov. 24, 1865	Spurrell, F. C. J., F.R.M.S., Belvidere, Kent, S.E.
Mar. 23, 1866	Starling, B., 11 Gray's-inn-square, W.C.
Nov. 23, 1866	Steet, G. C., F.R.C.S., 21 Myddelton-square, E.C.
Aug. 24, 1866	Steward, J. H., F.R.M.S., 406 Strand, W.C.

Date of Election.	
July 7, 1865	Suffolk, W. T., F.R.M.S., Claremont-lodge, Park-street, Camberwell, S.E.
Nov. 22, 1867	Swainston, J. T., 1 Victoria-road, Buckingham-gate, S.W.
Nov. 24, 1865	Swansborough, E., 6 Great James-street, Bedford-row, W.C.
June 26, 1868	Syms, F. R., 18 Manor-terrace, Brixton, S.W.
Nov. 22, 1867	Tarner, A. P., F.C.S., 97 High-st., Marylebone, W.
May 22, 1868	Tatem, J. G., Russell-street, Reading.
Dec. 22, 1865	Terry, J., 109 Borough-road, S.E.
Jan. 24, 1868	Tomkins, Samuel Leith, 26 Buckland-crescent, Belsize-park, N.W.
Oct. 26, 1866	Topping, C. M., A.R.M.S., 11 Loader's-terrace, Manor-road, Bermondsey, S.E.
July 24, 1868	Tulk, John A., M.D., Spring-grove, Isleworth, W.
July 24, 1868	Tulk, John A., F.R.M.S., &c., Firfield, Addlestone, Weybridge.
July 26, 1867	Turnbull, Joseph, 1 Clifton-villas, Highgate-hill, N.
Nov. 24, 1865	Turner, H., 77 Fleet-street, E.C.
Mar. 27, 1868	Tuson, Professor Richard V., Royal Veterinary College, N.W.
Mar. 27, 1868	Vallentin, J. Rose, 55 Cow-cross-street, E.C.
July 27, 1866	Veitch, Harry, F.H.S., The Royal Exotic Nursery, King's-road, Chelsea, S.W.
Feb. 23, 1866	Walker, A., Albion-road, Stoke Newington, N.
June 26, 1868	Walker, J. W., Fairfield-house, Watford.
Mar. 22, 1867	Wall, Alfred J., 46 Bessborough-st., Pimlico, S.W.
May 22, 1868	Waller, John G., 68 Bolsover-street, Portland-road, W.
Oct. 27, 1865	Wallis, George, South Kensington Museum, S.W.
Nov. 22, 1867	Ward, F. H., Manor-house, Poplar, E.
May 25, 1866	Warrington, H. R., 18 Upper Berkeley-street, N.
Oct. 27, 1865	Watkins, C. A., 10 Greek-street, Soho, W.

Date of Election.	
May 22, 1868	Watson, Thos. D., 18A Basinghall-street, E.C.
Sept. 22, 1865	Watson, T. G., 43 Poland-street, Oxford-street, W.
Aug. 23, 1867	Way, John, M.D., 4 Eaton-square, S.W.
Dec. 28, 1866	Way, T. E., 29 Wigmore-street, W.
May 24, 1867	Weeks, A. W. G., 18 Gunter's-grove, Chelsea, S.W.
July 7, 1865	West, H., 41 Strand, W.C.
Dec. 22, 1865	West, W., 54 Hatton-garden, E.C.
Dec. 22, 1865	Western, G., F.R.M.S., 42 Gerrard-st., Soho, W.
Aug. 4, 1865	Westgarth, W., 5 Hadley-street-north, Kentish-town, N.W.
Dec. 28, 1866	Wheldon, W., 58 Great Queen-street, W.C.
Oct. 26, 1866	White, F., 1 New-road, Commercial-road-east, E.
May 22, 1868	White, T. Charters, M.R.C.S., F.R.M.S., 22 Belgrave-road, S.W.
May 24, 1867	White, W., F.R.M.S., 3 Milners-st., Islington, N.
July 24, 1868	Wight, James F., F.R.M.S., 13 Bentham-road, South Hackney, N.E.
May 22, 1868	Wigner, John, B.A., Grove-terrace, Grove-lane, Camberwell, S.E.
May 22, 1868	Wild, E. G., 23 Acacia-road, St. John's-wd., N.W.
Nov. 22, 1867	Williams, R., 95 Queen's-crescent, Haverstock-hill, N.W.
Nov. 23, 1866	Willsmer, J., 98 Carlton-road, Kentish-town, N.W.
Jan. 25, 1867	Willsworth, H., 7 Whittington-terrace, Upper Holloway, N.
Feb. 23, 1866	Wilshin, J., 12 Totford-place, Neckinger, Bermondsey, S.E.
Feb. 22, 1867	Wilson, Frank, 110 Long-acre, W.C.
April 24, 1868	Withall, Henry, 1 The Elms, St. John's-road, Brixton, S.W.
Sept. 22, 1865	Wood, E. G., 74 Cheapside, E.C.
Oct. 25, 1867	Worthington, Richard, Champion-park, Denmark-hill, S.E.
Nov. 23, 1866	Wright, Edw., 23 Ashley-crescent, City-road, N.
Aug. 4, 1865	Wyatt, C. C., 9 North Audley-street, W.
Oct. 26, 1866	Yeats, Christopher, Mortlake, Surrey, S.W.
April 26, 1867	Young, J. T., 48 New-road, Whitechapel, E.

HONORARY FOREIGN MEMBERS.

Date of Election.	
Oct. 25, 1867	Guiseppe de Notaris, *Professor of Botany, &c., &c.,* Genoa.
Jan. 24, 1868	Arthur Meade Edwards, M.D. (*President of the American Microscopical Society of New York*), 49 Jane-street, New York.

BYE LAWS.

I. That "The Quekett Microscopical Club" shall hold its Meetings at University College, Gower Street, on the fourth Friday Evening in every month, at Eight o'clock precisely, or at such other time or place as the Committee may appoint.

II. That the business of the Club shall be conducted by a President, four Vice-Presidents, a Committee of twelve Members (four of whom shall be a quorum), a Treasurer, a Secretary, together with an Honorary Secretary for Foreign Correspondence, who however shall not be *ex officio* a member of the Committee, and the Editor of the Journal for the time being. That two of the retiring Vice-Presidents shall not be eligible for re-election. That the four senior members of the Committee (by election) retire annually and be not eligible for re-election; but such retiring members may be nominated by the Committee to fill the vacancies occurring otherwise than by regular annual retirement. Such retiring members are also eligible for nomination by independent Members of the Club, in accordance with the third paragraph of Rule III.

III. That the Officers and four members of the Committee shall be elected at the Annual Meeting in July. That the Committee shall prepare a list of names of gentlemen to be recommended to the Club for election as officers. This list shall be read at the ordinary Meeting in June; and any three or more Members who may be desirous of nominating any other Member or Members for election to any office shall have power to do so, provided such nomination be delivered to the Secretary duly signed, before the close of the Meeting; and the name or names of any Member or Members so proposed shall be printed on the balloting papers, below the names proposed by the Committee.

IV. That in the absence of the President and Vice-Presidents the Members present at any ordinary Meetings of the Club shall elect a Chairman for that evening.

V. That every Candidate for Membership shall be proposed by two or more Members, who shall sign a certificate (see Appendix) in recommendation of him—one of the proposers from personal knowledge. The certificate shall be read from the chair, and the candidate therein recommended shall be balloted for at the following Meeting, at which ballot three black balls shall exclude.

VI. That the Society shall include not more than twenty Foreign Honorary Members, who shall from time to time be elected by the Members by ballot, upon the recommendation of the Committee.

VII. That the Annual Subscription shall be Ten Shillings, payable in advance on the 1st of July, but that any Member elected in May or June shall be exempt from subscription until the following July of the same year. That no person shall be considered as a Member entitled to the full privileges of the Club until his subscription shall have been paid; and that any Member omitting to pay his subscription six months after the same shall have become due, shall, after two applications in writing have been made by the Treasurer, be deemed to have ceased to be connected with the Club.

VIII. That the Accounts of the Club shall be audited by two Members, one to be appointed by the Committee, and one to be elected by the Members present at the Meeting in June.

IX. That the Annual General Meeting be held on the fourth Friday in July, at which a General Report of the Committee on the affairs of the Club, and a Balance Sheet duly signed by the Auditors, shall be read. The Committee shall hand in a list of the names proposed for election as President, Vice-Presidents, Treasurer, and Secretaries; also the names of the four retiring members of the Committee, and the names of the Members recommended to fill their places; and the Chairman having

nominated two Members, not being members of the Committee, to act as Scrutineers, the Meeting shall then proceed to ballot. If from any cause these elections, or any of them, cannot take place at this Meeting, they shall take place at the next ordinary meeting of the Club.

X. That at the Ordinary Meetings the following shall be the Order of Business:—

(1) The minutes of the last Meeting shall be read and proposed for confirmation, and signed by the Chairman.

(2) Donations to the Club since the last Meeting shall be announced and exhibited.

(3) Certificates for new Members shall be read.

(4) Ballots for new Members shall be taken.

XI. That every Member shall have the privilege of introducing one Visitor at the Ordinary Meetings, who shall enter his name, together with the name of the Member by whom he is introduced, in a book to be kept for that purpose.

XII. That no alteration shall be made in these Bye Laws, except at an Annual General Meeting or a Special Meeting called for that purpose; and that notice in writing of any proposed alteration shall be given to the Committee, and read at the Ordinary Meeting at least a month previous to the Annual or Special Meeting, at which the subject of such alteration is to be considered.

APPENDIX.

QUEKETT MICROSCOPICAL CLUB.

Mr.

of

being desirous of becoming a Member of this Club, we beg to recommend him for election.

(on my personal knowledge).

This Certificate was read 186

The Ballot will take place 186

RULES FOR THE EXCHANGE OF SLIDES.

I. That all Slides be deposited with the Exchange Committee.

II. That not more than two similar Slides be placed in the Exchange Box at one time by any one member.

III. That the Slides be classified by the Committee into Sections, numbered according to quality.

IV. Members to select from the class in which their Slides are placed, at the ordinary meetings of the Club.

V. Members may leave the selection to the Exchange Committee, if they prefer it.

VI. Slides once exchanged cannot be exchanged again.

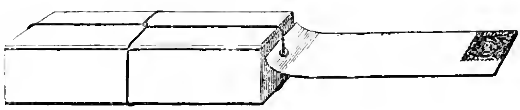
VII. A Register shall be kept, in which the Slides deposited shall be entered and numbered, with the date of receipt, and in which exchanges shall also be noted.

VIII. All expenses incurred in the transmission of Slides, or in correspondence respecting them, to be borne by the member on whose account such charges may be incurred.

Parcels may be addressed—

Mr. W. M. Bywater,
192, Piccadilly,
London, W.
[Exchange.]

Note.—As much inconvenience frequently arises from the breakage of Slides in transmission through the Post, the following method is recommended:—Pack the Slides in a small wooden box, which can be obtained of any Optician, tie it securely with string, and attach a slip of parchment to one end, sufficiently large to receive the Postage Stamps, Address, and local Post-office Stamps during transmission.



If paper be used as a wrapper to the box, the colour should be *black*.

When twelve or more Slides are sent, they should be packed in a racked box and forwarded by Railway.

QUEKETT MICROSCOPICAL CLUB,

MEETING AT

UNIVERSITY COLLEGE, GOWER STREET, LONDON.

The ordinary Meetings will be held on the following Evenings:—

1868.—Friday,		August	28.
	,,	September	25.
	,,	October	23.
	,,	November	27.
	,,	December	18.
1869.	,,	January	22.
	,,	February	26.
	,,	March	19.
	,,	April	23.
	,,	May	28.
	,,	June	25.

And the Annual General Meeting on July 23, 1869.

Commencing at 8 o'clock.

FOURTH REPORT

OF THE

QUEKETT MICROSCOPICAL CLUB,

AND

LIST OF MEMBERS.

MEETING AT UNIVERSITY COLLEGE, LONDON, ON THE FOURTH FRIDAY OF EVERY MONTH AT EIGHT O'CLOCK.

OFFICES: 192, PICCADILLY,
LONDON.

July 1869.

(Extract from original Prospectus, July 1865.*)*

"The want of such a Club as the present has long been felt, wherein Micro-
"scopists and students with kindred tastes might meet at stated periods to hold
"cheerful converse with each other, exhibit and exchange specimens, read papers
"on topics of interest, discuss doubtful points, compare notes of progress, and
"gossip over those special subjects in which they are more or less interested:
"where, in fact, each member would be solicited to bring his own individual
"experience, be it ever so small, and cast it into the treasury for the general good.
"Such are some of the objects which the present Club seeks to attain. In
"additon thereto it hopes to organize occasional Field Excursions, at proper
"seasons, for the collection of living specimens, to acquire a Library of such
"books of reference as will be most useful to enquiring students; and, trusting
"to the proverbial liberality of Microscopists, to add thereto a comprehensive
"Cabinet of Objects. By these, and similar means, the Quekett Microscopical
"Club seeks to merit the support of all earnest men who may be devoted to such
"pursuits; and, by fostering and encouraging a love for Microscopical studies, to
"deserve the approval of men of science and more learned societies."

OFFICERS AND COMMITTEE.

(Elected July, 1869.)

President.

PHILIP LE NEVE FOSTER, M.A.

Vice-Presidents.

R. BRAITHWAITE, M.D., F.L.S.
WITHAM M. BYWATER.
ARTHUR E. DURHAM, F.L.S., &c.
H. F. HAILES.

Treasurer.

ROBERT HARDWICKE, F.L.S.

Secretary.

T. CHARTERS WHITE.

Secretary for Foreign Correspondence.

M. C. COOKE.

Committee.

W. J. DE L. ARNOLD.
J. SLADE.
T. W. BURR, F.R.A.S., &c.
F. W. GAY.
W. J. GRAY, M.D.
R. T. LEWIS.
J. BOCKETT.
T. KETTERINGHAM.
S. J. McINTIRE.
B. T. LOWNE, M.R.C.S.
T. CROOKE.
J. MATTHEWS, M.D.

Librarian.

EDWARD JAQUES.

Curator.

G. W. RUFFLE.

Editor.

W. HISLOP, F.R.A.S.

Excursion Committee.

W. J. DE L. ARNOLD.
F. W. GAY.
W. W. REEVES.
W. T. SUFFOLK.

Exchange (of Slides) Committee.

J. BOCKETT.
H. F. HAILES.
W. HISLOP.
E. MARKS.

PAST PRESIDENTS.

		Elected.
EDWIN LANKESTER, M.D., F.R.S.	- -	July, 1865.
ERNEST HART	- - - - - -	„ 1866.
ARTHUR E. DURHAM, F.L.S., &c.	- -	„ 1867.
„ „ „	- -	„ 1868.

REPORT OF THE COMMITTEE.

In presenting the *Fourth Annual Report*, the Committee of the Quekett Microscopical Club have great pleasure in again congratulating the members on the continued prosperity and increasing success of the Club. Very considerable additions have been made to the list of members, the meetings have been increased in frequency, and the large attendances thereat have evinced well sustained interest in the proceedings.

At the last Annual Meeting the Committee expressed a hope that arrangements would speedily be made by which more frequent opportunities of meeting during the winter months would be afforded. This hope has been fully realised. By the liberality of the Council of University College your Committee were enabled to make the experiment of holding extra meetings for conversation and the exhibition of specimens. The success of these meetings was so great that the Council of the College have readily consented to their continuance, in addition to renewing permission for the ordinary meetings during the present year. Your Committee cannot sufficiently express their appreciation of

the advantages thus freely conferred upon the Club by the authorities of the college.

During the year just completed the "Journal of Transactions" has appeared at the usual quarterly periods. Your Committee trust the objects for which it was projected are being attained, that by it absent members are made better acquainted with the proceedings of the Club, and that it is thus becoming a means of bringing members into closer intercourse.

It will be interesting to members to be informed that the *soirée* given in March last was eminently successful. It was attended by upwards of 1,400 members and friends, and very many interesting objects were exhibited. The Committee desire to express their cordial thanks to those gentlemen by whose assistance they were enabled to carry out their plans to so successful an issue.

The papers* which have been read during the past year have been full of interest, and have appeared in the Journal as nearly *in extenso* as space would allow. The Committee trust that during the ensuing year an increased number of members will contribute papers embodying the results of some of their investigations.

The slides in the Cabinet amount in number to 1,242, the following additions having been received during the year:—

* For list of papers and authors, see appendix at page 10.

Mr. Collins	2
,, Cooke	427
,, Curties	8
Dr. Dempsey	4
Mr. Edmonds	6
,, Golding	19
,, Groves	1
,, Hislop	24
,, Kilsby	1
,, G. H. King	4
,, Kitton	4
,, Martinelli	1
Dr. Perley	6
Mr. Quick	10
,, Russell	18
,, Slade	6
	541

The slides are under the care of Mr Ruffle, to whom the Club is greatly indebted for the facilities which exist for their proper examination.

Numerous Books of Reference have been added to the Library from time to time by purchases and donations. By the earnest co-operation of Mr. Jaques the books have been very generally circulated on the nights of meeting.

The exchange of slides is now in full operation under the superintendence of Messrs. Bockett, Hailes, Hislop, and

Marks, who have succeeded in carrying out the duties that have devolved upon them most satisfactorily. During the past year about 300 slides have been exchanged.

The Excursions form a feature in the Club, and their sustained success is a matter for much congratulation. As the result of the well organised arrangements of the Excursion Committee (Messrs. Arnold, Gay, Reeves, and Suffolk) the meetings have been exceedingly well attended, and the localities for exploration have been admirably selected and diversified. It is hoped that together with the fortnightly meetings in the College the excursions have proved sources of gratification to those who have attended them, and of instruction to those who have been enabled to examine the objects collected.

These excursions afford opportunities for research and investigation such as few other Societies in London can supply. Your Committee hope to receive at the termination of this season more copious records of the objects collected and their habitats, as noted by members, than have hitherto been furnished. They therefore venture to impress upon all members the desirability of assisting in this matter. Such a course cannot fail to be advantageous as well to the observer as to the general body of microscopists. It is intended that the results of the excursions shall form a chapter in the Journal.

Since the last Annual Report 142 new members have been admitted into the Club, and 12 names have been with-

drawn. Consequently the present number of members is 512. If numbers can be adduced as evidence of success the Committee will be justified in offering their hearty congratulations. They believe it is almost unparalleled that 560 members should have joined any Society, allied however remotely to science, in the short space of four years, accompanied by so small a reduction by reason of death or other causes.

These four years of success have left us a legacy in the shape of great responsibilities, which we must perforce accept. If the opportunities afforded to members be great, the demand upon them for increased exertion is proportionably great.

Let no one, therefore, work for his own gratification alone, but let each strive to contribute to the general fund of information, ever bearing in mind that whatever he may have met with interesting to himself may be interesting to others also. There is nothing in the field of nature so insignificant but that it may prove of value to some one or other of the members who has accustomed himself to investigate whatever may come under his notice, and who has made

"The fields his study—nature his book."

July 23rd, 1869.

PAPERS READ DURING THE YEAR.

MR. MARTINELLI -	On "The Tubules in the Shell of the Crab."
" SLADE - -	" "The Preparation of sections of Tooth and Bone for Microscopical Examination."
" McINTIRE -	" "Cheyleti."
" T. C. WHITE -	" "A New Cement for microscopical purposes."
" TATEM - -	" "A New Melicertian, and on Melicerti Ringens."
" LOWNE - -	" "The Proboscis of the Blow Fly."
" HOPKINSON -	" "British Graptolites."
" HOLMES - -	" "A new form of Binocular Microscope."
" SUFFOLK - -	" "Some of the means of delineating microscopical objects."
" JORDAN - -	" "The preparation of Rock Sections for microscopical examination."
" M. C. COOK -	" "Bunt Spores."
" SUFFOLK - -	" "A method of drying microscopical objects."
" WIGHT - -	" "A method of coating glass chimneys."
" LOWNE - -	" "The anatomy of the Blow Fly."
" LOWNE - -	" "A Secretion from the Stomach of the Flamingo."
" LOWNE - -	" "The Imaginal Discs of Dr. August Weismann."
" HIGHLEY - -	" "The Rev. J. B. Reade's method of Illumination."

TREASURER'S REPORT.

JUNE 30th, 1869.

RECEIPTS.	£	s.	d.	PAYMENTS.	£	s.	d.
Balance in hand at last Audit - - -	62	0	9	Printing and Stationery - - - - -	27	15	0
Subscriptions received from July 1, 1868, to June 30th, 1869 - - - -	195	0	0	Postages - - - - - -	12	12	9
				Advertisements - - - - -	4	17	3
				Attendants - - - - - -	7	17	6
				Property Purchased - - - - -	26	13	3
				Petty Expenses - - - - -	13	12	6
				Expenses of Soirée - - - - -	61	9	4
				Journal, Nos. 3, 4, 5, and 6—nett cost -	79	3	11
				Balance at Banker's - - - - -	22	19	3
	£257	0	9		£257	0	9

ROBERT HARDWICKE, *Treasurer.*

We, the undersigned, having examined the above Statement of Income and Expenditure, and the Vouchers referring thereto, hereby certify that the said Account is correct.

W. T. SUFFOLK, } *Auditors.*
E. MARKS,

HONORARY FOREIGN MEMBERS.

Date of Election.	
Oct. 25, 1867	Guiseppe de Notaris, *Professor of Botany, &c., &c.,* Genoa.
Jan. 24, 1868	Arthur Meade Edwards, M.D., 49 Jane-street, New York.
Mar. 19, 1869	Rev. E. C. Bolles *(President of the Portland Society of Natural History)*, Portland, Maine, U.S.
Mar. 19, 1869	Alphonse de Brebisson *(Author of numerous contributions on the Desmidiaceæ and Diatomaceæ)*, Falaise, Normandy, France.

LIST OF MEMBERS.

Date of Election.	
Nov. 27, 1868	Adkins, William, 270 Oxford-street, W.
Oct. 27, 1865	Aldous, W. Lens, 47 Liverpool-street, W.C.
Mar. 19, 1869	Alexander, Josias, 2 Regent's Park Gardens, Primrose-hill, N.W.
Mar. 23, 1866	Allbon, W., F.R.M.S , 525 New Oxford-street, W.C.
Jan. 22, 1869	Allder, J. R., 5 Suffolk-street, Rotherfield-street, Islington, N.
Sept. 27, 1867	Allen, John T., 57 Cross-street, Islington, N.
July 23, 1869	Allen, W. H., C.E., 2 Abingdon-villas Kensington, W.
Sept. 25, 1868	Andrew, Arthur R., 3 Neville-terrace, Fulham-road, S.W.
Dec. 22, 1865	Andrew, F. W., 3 Neville-terrace, Fulham-road, S.W.
Sept. 22, 1865	Annett, James, Hampton, S.W.
July 7, 1856	Archer, J. A., 172 Strand, W.C.
Oct. 27, 1865	Arnold, W. J. de L., 6 Stamford-villas, Fulham, S.W.
Jan. 25, 1867	Arrow, James, Jun., 12 North-terrace, Clapham, S.W.
Dec. 18, 1868	Ashby, John, Staines.
Aug. 28, 1868	Atkinson, C., Wingfields, Snaresbrook, N.E.
Dec. 22, 1865	Atkinson, John, 54 Brook-street, W.
Feb. 26, 1869	Atkinson, William, F.L.S., 47 Gordon-square, W.C.
Mar. 27, 1868	Aubert, Alfred, Lloyds, E.C.
May 22, 1868	Bailey, Capt. L. C., R.N., F.R.G.S., R.A.S., Topographical Dept., New-st., Spring-gardens, S.W.
July 26, 1867	Bailey, George H., M.R.C.S., 25 Charles-street, Middlesex Hospital, W.
Dec. 27, 1867	Bailey, John W., 162 Fenchurch-street, E.C.

Date of Election.	
April 24, 1868	Baker, Charles, F.R.M.S., 244 High Holborn, W.C.
July 27, 1866	Baker, St. Thomas, F.R.M.S., 184 King's-road, Chelsea, S.W.
Aug 23, 1867	Bannister, Richard, F.R.M.S., The Laboratory, Somerset-house, W.C.
Jan. 26, 1866	Barber, John, F.R.M.S., 29 Brunswick-gardens, Campden-hill, W.
June 26, 1868	Barnard, J. C., 139 Newington-causeway, S.E.
Jan. 24, 1868	Barnes, Fancourt, 46 Finsbury-square, E.C.
Nov. 23, 1866	Barnes, Capt. E., York.
Oct. 27, 1865	Barratt, T. J., 91 Great Russell-street, W.C.
June 25, 1869	Beale, Charles J., 118 Englefield-road, Islington, N.
Dec. 27, 1867	Bealey, Adam, M.D., 27 Tavistock-square, W.C.
May 28, 1869	Bean, Charles E., Brooklyn House, Goldhawk-road, Shepherd's Bush, W.
Aug. 23, 1867	Beazeley, Joseph, 17 Little Tower-street, E.C.
Oct. 26, 1866	Beck, Joseph, F.R.M.S., 31 Cornhill, E.C.
Nov. 23, 1866	Becker, Chas., 21 Florence-street, Islington, N.
Nov. 23, 1866	Beigell, Hermann, M.D., 3 Finsbury-square, E.C.
Aug. 23, 1867	Bell, James, F.R.M.S., The Laboratory, Somerset-house, W.C.
Mar. 19, 1869	Bennett, C., Jun., 30 Gloucester-street, Pimlico, S.W.
Dec. 27, 1867	Bentley, C. S., Hazellville Villa, Sunnyside-road, Hornsey-rise, N.
May 22, 1868	Berney, John, F.R.M.S., 61 North-end, Croydon.
Nov. 23, 1866	Betts, Arthur R., F.R.M.S., 1 St. John's-park-villas, Upper Holloway, N.
Oct. 23, 1868	Bevington, W. A., 113 Grange-road, S.E.
May 25, 1866	Bezant, W. F., F.R.M.S., 7 Whittington-terrace, Highgate-hill, N.
Mar. 27, 1868	Bidlake, J. P., B.A., F.C.P., F.C.S., F.R.M.S., 318 Essex-road, N.
Jan. 25, 1867	Bird, Peter Hinckes, M.D., 1 Norfolk-square, Hyde-park, W.
Oct. 26, 1866	Bithell, Richd., B.Sc., Ph.D., Acacia-cottage, London-road, Clapton, N.E.
Nov. 22, 1867	Blake, F. W., 5 Serle-street, Lincoln's-inn, W.C.
Feb. 23, 1866	Blake, T., 6 Charlotte-terrace, Brook-green, Hammersmith, W.

Date of Election.

Mar. 19, 1869	Blankley, Frederick, F.R.M.S., 23 Belitha-villas, Barnsbury, N.
Mar. 19, 1869	Blight, Rev. R., The Vicarage, Bredwardine, Hereford.
July 7, 1865	Bockett, John, F.R.M.S., 10 Willingham-terrace, Leighton-road, Kentish-town, N.W.
April 24, 1868	Bodkin, W. P., Merton-lane, Highgate-rise, N.
June 25, 1869	Bond, George, 11 St. Thomas'-place, Hackney, N.E.
Nov. 27, 1868	Boustead, James, Stourfield Lodge, Effra-road, Brixton, S.E.
Mar. 27, 1868	Bowing, John, 6 Bowater-crescent, Woolwich, S.E.
July 23, 1869	Boyer, Richard, 20 Park-terrace, Highbury, N.
Oct. 23, 1868	Brabham, T., 61 Castle-street, Leicester-square, W.C.
Dec. 22, 1865	Brain, T., Buckingham-house, Buckingham-road, De Beauvoir-town, N.
Oct. 27, 1865	Braithwaite, R., M.D., M.R.C.S.E., F.L.S., F.R.M.S., (*Vice-President*), The Ferns, Clapham-rise, S.W.
Nov. 24, 1865	Breese, C. J., F.R.M.S., The Ferns, Lyonsdown-road, New Barnet.
June 26, 1868	Briggs, H. B., 36½ Upper Thames-street, E.C.
Mar. 22, 1867	Brightween, G., 8 Finch-lane, E.C.
Jan. 22, 1869	Brookes, William, 380 Camden-road, Holloway, N.
Dec. 28, 1866	Brown, W., 203 Great Portland-street, W.
May 22, 1868	Brown, W. J., 20 Groombridge-road, South Hackney, N.E.
May 24, 1867	Browne, H., 40 Camden-square. N.W.
Oct. 26, 1866	Bruce, R., M.B., &c., 6 Albert-terrace, Regent's-park, N.W.
May 25, 1866	Buchanan, A., 11A Myddelton-square, E.C.
Sept. 28, 1866	Burgess, J. W., 329 Hackney-road, N.E.
Feb. 23, 1866	Burgess, N., 329 Hackney-road, N.E.
June 25, 1869	Burgess, W. F., Guy's Hospital, S.E.
April 24, 1868	Burr, T. W., F.R.A.S., F.C.S., F.R.M.S., 15 Tibberton-square, N.
Oct. 23, 1868	Burrows, C. R. N., Wanstead, Essex, N.E.
April 24, 1868	Burrows, John, Wanstead, N.E.
Mar. 27, 1868	Burrows, J. Nelson, The Grove, Wanstead, N.E.
June 14, 1865	Bywater, Witham M., F.R.M.S. (*Vice-President*), 5 Hanover-square, W.
July 27, 1866	Bywater, W. M., Jun., 5 Hanover-square, W.

Date of Election.	
May 24, 1867	Callaghan, James, 12 Coal-yard, W.C.
Nov. 24, 1865	Callow, T., 8 Park-lane, Piccadilly, W.
Aug. 23, 1867	Cameron, J., The Laboratory, Somerset-house, W.C.
Sept. 25, 1868	Capel, Charles C., Little Blake Hall, Wanstead, Essex.
Dec. 27, 1867	Chapman, W. C., 39 Granville-square, W.C.
Oct. 25, 1867	Clabon, J. M., F.G.S., 4 St. George's-terrace, Regent's-park, N.W.
Mar. 19, 1869	Clark, Edwin, Observatory House, Forest-hill, S.E.
Dec. 22, 1865	Clarke, T. T., Swakeleys, near Uxbridge, Middlesex.
Mar. 22, 1867	Clover, Jos. T., 3 Cavendish-place, Cavendish-square, W.
May 22, 1868	Cocks, W. G., 18 Kent-villas, Grange-road-east, Dalston, N.E.
Dec. 10, 1868	Coe, W. E., 31 Gaisford-st., Kentish-town-road, N.W.
Feb. 22, 1867	Cogswell, Chas., M.D., 47 York-terrace, Regent's-park, N.W.
July 7, 1865	Cole, A., 22 Hunter-street, Brunswick-square, W.C.
May 28, 1869	Cole, Walter B., 17 Mary-street, Weymouth.
Jan. 25, 1867	Coles, Ferdinand, A.P.S., 248 King's-road, Chelsea, S.W.
April 23, 1869	Collings, Thomas P., 38 Surrey-street, Strand, W.C.
July 7, 1865	Collins, C., F.R.M.S., 77 Great Titchfield-street, W.
May 22, 1868	Collins, Jas., 11 Arthur-street, Deptford, S.E.
Mar. 19, 1869	Conder, George, Plough-court, Lombard-street, E.C.
Mar. 19, 1869	Cooke, George E., 4 Loddiges-terrace, Hackney, N.E.
June 14, 1865	Cooke, M. C. (*Sect. for Foreign Correspondence*), 2 Junction-villas, Upper Holloway, N.
Feb. 22, 1867	Cooper, Frank W., L.R.C.S. Edin., Leytonstone, N.E.
Mar. 23, 1869	Coppock, C., F.M.S., F.R.M.S., 31 Cornhill, E.C.
May 28, 1869	Cottam, Arthur, F.R.A.S., Office of Woods, White-hall, S.W.
Aug. 28, 1868	Cousens, John, Grove-road, Wanstead, N.E.
Feb. 26, 1869	Crafer, Reginald, Carshalton, Surrey.
July 23, 1869	Creer, Edwin A. O., 2 Albany-place, Commercial-road East, E.
Aug. 4, 1865	Cresy, E., Metropolitan Board of Works, Spring-gardens, S.W.
Aug. 28, 1868	Crisp, Frank, 134 Adelaide-road, N.W.

Date of Election.	
Feb. 27, 1868	Crook, Thomas, F.R.M.S., Grosvenor-villa, Cleveland-road, Surbiton, S.W.
Oct. 26, 1866	Crookes, William, F.R.S., 20 Mornington-rood, N.W.
July 7, 1865	Crosbie, J. J., 11 Grange-road, Canonbury, N.
July 26, 1867	Cross, R., M.D., 21 New-street, Spring-gardens, S.W.
Sept. 28, 1866	Crouch, Henry, F.R.M.S., 54 London-wall, E.C.
Aug. 23, 1867	Crowther, James, 7 Tyrwhitt-road, Lewisham-road, S.E.
Mar. 27, 1868	Cubitt, Charles, F.R.M.S., 3 Great George-street, Westminster, S.W.
Nov. 23, 1866	Cumming, John, F.G.S., 7 Montague-place, Russell-square, W.C.
May 25, 1866	Curties, T., F.R.M.S., 244 High Holborn, W.C.
June 25, 1868	Darnley, D. Rowland, 12 John-street, Bedford-row, W.C.
April 27, 1866	Davis, S., 11 Priory-road, South Lambeth, S.W.
Sept. 28, 1866	Dawson, George, M.A., King's-college, W.C.
May 25, 1866	Dawson, J. E., F.R.M.S., Oak Lodge, Park-road, Watford.
May 22, 1868	Dean, G. A. H., Elmwood, Catford-bridge, Kent, S.E.
Jan. 22, 1869	Deed, Alfred, 4 Eton-villas, Haverstock-hill, N.W.
Nov. 27, 1868	Delferier, William, F.R.M.S., 40 Sloane-square, S.W.
April 23, 1869	Delferier, W., Junr., 40 Sloane-square, S.W.
Feb. 27, 1868	Dempsey, Joseph M., M.D., F.R.M.S., 27 Charter-house-square, E.C.
Jan. 26, 1866	Denman, J.L., F.R.M.S., 27 Kensington-gardens-square, Hyde-park, W.
July 23, 1869	Devenish, Samuel, 2 Champion-grove, Denmark-hill, S.E.
June 26, 1868	Dickens, Charles, Stanstead-park, Forest-hill, S.E.
Dec. 22, 1865	Dix, James, 26 Pentonville-road, N.
Sept. 22, 1865	Dixon, E. A., 14 Dalston-terrace, N.E.
Nov. 24, 1865	Dobson, H. H., F.R.M.S., Pelham Lodge, Alexandra-road, St. John's-wood, N.W.
Jan. 25, 1867	Dodd, Josiah E., 11 Margaret-street, Cavendish-square, W.

Date of Election.	
Aug. 28, 1868	Donaldson, Alexander L., 4 Upper Berkeley-street, Portman-square, W.
Nov. 27, 1868	Douglas, Rev. R. C., Manaton Rectory, Moreton-hampstead, Exeter.
Dec. 27, 1867	Draper, E. T., F.R.M.S., Harringay-park, Hornsey, N.
May 22, 1868	Dresser, W. G., 68 Westbourne-road-north, Barnsbury, N.
Sept. 22, 1865	DURHAM, ARTHUR, E. F.L.S., F.R.M.S. (*Vice-President*), 82 Brook-street, Grosvenor-square, W.
Nov. 23, 1866	Durham, F., 14 St. Thomas-street, Borough, S.E.
Aug. 26, 1868	Duer, Y., Cleygate, near Esher, Surrey,
Sept. 25, 1868	Eddy, James Ray, F.R.M.S., F.G.S., Carleton-grange, Skipton, Yorkshire.
June 28, 1867	Edmonds, R., 176 Maxey-road, Plumstead, S.E.
July 26, 1867	Eldridge, John R., 20 Downshire-hill, Hampstead, N.W.
July 27, 1865	Emery, J. J., 99 St. George's-road, Southwark, S.E.
May 28, 1869	Evans, Edward, 12 Surrey-villas, Norwood, S.E.
Feb. 26, 1869	Evans, Fredk., 51 Malpas-road, New-cross, S.E.
Dec. 18, 1868	Eyre, Samuel, 10 Upper Lansdowne-road-north, South Lambeth, S.E.
May 28, 1869	Farmer, Richard, F.R.M.S., F.G.S., Hornsey, N.
Dec. 18, 1868	Farmer, Robert J., 5 Great-turnstile, Holborn, W.C.
Nov. 23, 1866	Fawn, George, 125 Stanley-street, Pimlico, S.W.
Mar. 22, 1867	Fearns, Francis H., Westmoreland-house, Walworth-common, S.E.
Mar. 27, 1868	Field, James, High-street, Highgate, N.
July 26, 1867	Fitch, Frederick, F.R.G.S., F.R.M.S., Hadleigh-house, Highbury New-park, N.
May 22, 1868	Ford, W. B., 107 St. John-street-road, E.C.
Aug. 4, 1865	FOSTER, P. LE NEVE, M.A. (*President*), Society of Arts, Adelphi, W.C.

Date of Election.	
Aug. 24, 1866	Foster, P., F.L.S., Belsize-lane, Hampstead, N.W.
Dec. 28, 1866	Fox, C. J., F.R.M.S., 16 Cork-street, Bond-street, W.
Mar. 27, 1868	Fox, John James, Devizes.
Dec. 22, 1865	Fox, Tilbury, M.D., M.R.C.P., 43 Sackville-street, Piccadilly, W.
May 25, 1866	Freeman, W., 2 Ravensbourne-hill, Greenwich, S.E.
Feb. 26, 1869	Fricker, C. J., 4, Weston-hill-terrace, Upper Norwood, S.E.
June 26, 1868	Fry, Rev. James, M.A., F.R.M.S., Monson-villa, Redhill, Surrey.
May 22, 1868	Fryer, G. Henry, F.R.M.S., 13 West Abbey-road, St. John's-wood, N.W.
May 28, 1869	Fryer, G. H., 22 North-road, Clapham-park, S.W.
Oct. 25, 1867	Furlonge, W.H., 4 Oxford-road, Hammersmith, W.
Mar. 19, 1869	Gann, James W., 171 Fenchurch-street, E.C.
May 25, 1866	Gardiner, G., 244 High Holborn, W.C.
April 24, 1868	Garnham, John, F.R.M.S., 123 Bunhill-row, E.C.
July 7, 1865	Gay, F. W., F.R.M.S, 113 High Holborn, W.C.
Sept. 22, 1865	Geddes, P., Millbank, Westminster, S.W.
July 26, 1867	George, Edward, F.R.M.S , 12 Derby villas, Forest-hill, S.E.
Mar. 22, 1867	George, Henry, 65 Castle-street, Oxford-market, W.
June 14, 1865	Gibson, W., 9 Lupus-street, Pimlico, S.W.
Aug. 23, 1867	Gilbert, C. H. D., 65 Ludgate-hill, E.C.
Nov. 23, 1866	Gill, F. W., Bedford-villas, Croydon.
Nov. 22, 1867	Golding, W. H., 73 Mark-lane, E.C.
Oct. 26, 1866	Gooch, James W., 23 High-street, Eton.
Dec. 22, 1865	Goode, W., 127 St. George's-square, Pimlico, S.W.
Dec. 28, 1866	Goss, S.D., M.D., F.R.G.S., 24 Newington-place, Kennington-park, S.E.
Feb. 22, 1867	Gostling, W., Edgecumbe-villa, Upper Tooting, S.W.
Aug. 27, 1869	Gowan, G. O., 20 Beauchamp-square, Leamington.
Mar. 27, 1868	Gray, S. Octavus, 1 St. George's-terrace, Dalston-rise, N.E.
Dec. 22, 1865	Gray, W. J., M.D., F.R.M.S., 41 Queen Anne-street, Cavendish-square, W.
Jan. 22, 1869	Greenfield, Basil E , 6 Gordon-square, W.C.

Date of Election.	
Oct. 23, 1868	Greenish, T., 20 New-street, Dorset-square, N.W.
Oct. 23, 1868	Gregory, Henry R., 21 Great College-street, Westminster, S.W.
May 25, 1866	Griffiths, A. W., 41 Clerkenwell-green, E.C.
July 24, 1868	Groves, J. W., 25 Charlotte-street, Bedford-square, W.C.
July 24, 1868	Grubbe, E. W., C.E., 49 Queen's-gardens, Hyde-park, W.
June 14, 1865	Hailes, Henry F. (*Vice-President*), 49 Offord-road, Barnsbury, N.
Aug. 23, 1867	Hainworth, John, 138 Camden-road, N.W.
Feb. 23, 1866	Hainworth, W., Jun., Clare-villa, Cricketfield-road, Lower Clapton.
Mar. 19, 1869	Hall, Marshall, F.G.S., F.C.S, 3 Cleveland-terrace, Hyde-park, W.
Dec. 28, 1866	Hallett, R. J., Hawthorn-cottage, Kilburn, N.W.
Oct. 26, 1866	Halley, Alexander, M.D., 7 Harley-street, W.
Feb. 22, 1869	Hammond, A., 3 Alexander-road, Marine Town, Sheerness.
Dec. 22, 1865	Hancock, John C., 7 Grantham-place, Coburg-road, Old Kent-road, S.E.
June 14, 1865	Hardwicke, Robert, F.L.S. (*Treasurer*), 192 Piccadilly, W.
Feb. 22, 1869	Harker, John W., F.R.M.S., 24 Upper Barnsbury-street, N.
Sept. 28, 1866	Harkness, W., F.R.M.S., Laboratory, Somerset-house, W.C.
Jan. 22, 1869	Harper, J., Claremont-house, Chaucer-road, Brixton, S.E.
May 22, 1868	Harris, W. H., F.C.S., Buckby Wharf, Northamptonshire.
Aug. 24, 1866	HART, ERNEST, 69 Wimpole-street, W.
Oct. 26, 1866	Hart, G. W., Mengeham-house, Hayling, Havant.
Aug. 23, 1867	Harvey, Wm., 38 Dale-road, Haverstock-hill, N.W.
June 26, 1868	Haward, Alfred, Shirley-villas, Croydon.
June 28, 1867	Hawksley, Thos. P., 5 Windermere-road, Upper Holloway, N.
Mar. 23, 1866	Hazard, H., 455 New Cross-road, S.E.

Date of Election.	
Aug. 28, 1868	Heawood, Francis R. H., 80 Mark-lane, E.C.
Jan. 25, 1867	Heisch, Charles, F.R.M S., 69 Jermyn-street, St. James's, S.W.
Aug. 23, 1867	Helm, Henry J., F.R.M.S., The Laboratory, Somerset-house, W.C.
June 26, 1868	Henry, A. H., 49 Queen's-gardens, Hyde-park, W.
May 22, 1868	Hewitt, B.A., 9 Percy villas, Upper Norwood, S.E.
May 22, 1868	Hicks, J. J., 8 Hatton-garden, F.C.
Nov. 24, 1868	Hide, T. C., 46 Fenchurch-street, E.C.
June 14, 1865	Highley, S., F.G.S., 10A Great Portland-street, W.
May 22, 1868	Hill, W. T., 4 Trinidad-place, Liverpool-road, N.
Sept. 28, 1866	Hind, F. H P., 4 Pall-mall-east, S.W.
Nov. 23, 1866	Hinton, James, 18 Savile-row, W.
Aug. 4, 1865	Hislop, W., F.R.A.S. (*Editor*), 177 St. John-street-road, Clerkenwell, E.C.
Oct. 26, 1866	Holdernesse, W. B., 12 Park-street, Windsor.
May 22, 1868	Holdsworth, Joseph, 54 Lombard-street, E.C.
Mar. 22, 1867	Holmes, Samuel, 12 Brunswick-terrace, Lower-road, Rotherhithe, S.E.
July 24, 1868	Holmes, W., M.R.C.S., 1 Brighton-villas, Lower Norwood, S.E.
April 24, 1868	Holmes, W. M., 338 Oxford-street, W.
April 27, 1866	Holtzapffel, J., A.I.C.E., 5 Great Coram-st., W.C.
April 26, 1867	Hooton, C., 3 Horningston-villas, Junction-rd., N.
May 22, 1868	Hopkinson, J., F.R.M.S., 8 Lawn-road, Haverstock-hill, N.W.
July 23, 1869	Horn, William E., 50 Bessborough-street, S.W.
Oct. 26, 1866	Horncastle H., Edwinstowe, near Ollerton, Notts.
June 25, 1869	Houghton, W., Walthamstow, Essex.
April 26, 1867	Hovenden, F., 93 City-road, E.C.
Mar. 27, 1868	How, James, F.R.M.S., 2 Foster-lane, E.C.
Oct. 23, 1868	Hughes, R. H., B.A., Jesus Coll., Camb., 6 The Terrace, Putney, S.W.
Oct. 27, 1865	Hugman, W., Jun., 55 Guildford-street, Russell-square, W.C.
June 25, 1869	Humphreys, Hy., B.A., 9 Amhurst-road-west, N.E.
Dec. 28, 1866	Hunt, W. H. B., F.R.M.S., 23 Eversholt-street, Oakley-square, N.W.
May 24, 1867	Hutchinson, F., M.D., 29 Woburn-place, Russell-square, W.C.

Date of Election.	
May 28, 1869	Ibbetson, D., 68 Amberley-road, Harrow-road, Bayswater, W.
May 24, 1867	Ingpen, John E., F.R.M.S., 7 Putney-hill, S.W.

July 24, 1868	Jackson, F. R., Maple-villa, West Dulwich, S.E.
June 14, 1865	Jaques, Edward, F.R.M.S. *(Librarian)*, Woods and Forests Office, Whitehall, S.W.
June 26, 1868	Jeakes, Lt.-Colonel, Winchester Hall, Highgate, N.
Apl. 23, 1869	Jefferson, Thomas, 17 The Pavement, Clapham Common, S. W.
July 24, 1868	Jennings, Rev. Nathaniel, M.A., F.R.A.S., 66 Avenue-road, Regents-park, N.W.
Jan. 24, 1868	Jewell, C. C., 2 Great Queen-street, W.C.
Mar. 23, 1866	Jobson, T. C. W., 22 Canonbury-villas, N.
Jan. 24, 1868	Johnson, Rev. Andrew, M.A., Grammar School, Horselydown, S.E.
Mar. 23, 1866	Johnson, E. D., F.R.A.S., 9 Wilmington-sq., W.C.
Jan. 25, 1867	Johnson, John A., Wellington-road, Stoke Newington, N.
Jan. 26, 1866	Johnson, R. G., Horbury-villa, Ladbroke-square, Notting-hill, W.
July 26, 1867	Johnson, R. H., 7 Wellington-terrace, New-road, Hammersmith, W.
Mar. 19, 1869	Jonas, L., E., 13 Canterbury-villas, Maida Vale, N.W.
Dec. 22, 1865	Jones, C., Devonshire-villa, Windsor-road, Ealing, W.
Dec. 18, 1868	Jordan, James B., 11 Grafton-square, Clapham, S.W.

Oct. 26, 1866	Kemp, Robert, 25 Junction-road, Upper Holloway, N.
Oct. 26, 1866	Kent, W. S., F.R.M.S., 56 Queen's-road, Notting-hill, W.
June 14, 1865	Ketteringham, T., 51 Coleshill-street, Eaton-square, S.W.
Aug. 23, 1867	Kiddle, Edward, The War Office, Pall-mall, S.W.
Mar. 19, 1869	Kilsby, Thomas W., Upper Fore-street, Edmonton, N.
July 7, 1865	King, G. H., 190 Great Portland-street, W.
Jan. 24, 1868	King, W. W., South-grove-west, Mildmay-park, N.
April 26, 1867	Kirk, Joseph, 11 Blossom-st., Norton Folgate, N.E.
Oct. 23, 1868	Knevett, S., 18 Montague street, Russell-square, W C.

Date of Election.	
July 27, 1866	Lambert, T. J., 151 Highbury New-park, N.
Nov. 23, 1866	Lambert, W., 4 New Basinghall-street, E.C.
Aug. 24, 1866	Lampray, John, F.R.G.S., F.A.S.L., F.R.M.S., 16 Camden-square, N.W.
Mar. 22, 1867	Lancaster, Thos., Brownham-house, Stroud, Gloucestershire.
Jan. 25, 1867	Lang, H., M.D., 41 Berners-street, W.
Oct. 26, 1866	Lang, Henry, 41 Berners street, W.
Dec. 28, 1866	Langrish, H., 250 Pentonville-road, N.
Aug. 4, 1865	LANKESTER, EDWIN, M.D., F.R.S., F.L.S., F.R.M.S., Melton House, Child's-hill, Hampstead, N.W.
Feb. 26, 1869	Lavey, Charles, 341 City-road, E.C.
Apl. 23, 1869	Lawson, Henry, M.D., 8 Nottingham-place, W.
June 25, 1869	Layton, Charles E., 8 Upper Hornsey Rise, N.
Aug. 28, 1868	Leaf, C. J., F.L.S., F.R.M.S., &c. (*President of the Old Change Microscopical Society*), Old Change, E.C.
Aug. 24, 1866	Leakey, J. W.
Mar. 19, 1869	Lee, Henry, F.L.S., F.R.M.S., &c, The Waldrons, Croydon.
Oct. 25, 1867	Leifchild, J. R., 42 Fitzroy-street, Fitzroy-sq., W.
Sept. 22, 1865	Leighton, W. H., 2 Merton-place, Chiswick, W.
June 25, 1869	Lemmon, Benj., 61 Hungerford-road, Islington, N.
May 28, 1869	Letts, Edmund A., Clare-lodge, Perry-hill, Sydenham, S.E.
Mar. 22, 1867	Lewinsky, John, 13 Frith-street, Soho, W.
Sept. 28, 1866	Lewis, H. W., 3 Medina-cottages, Seven Sisters-road, N.
Jan. 22, 1869	Lewis, Louis, M.R.C.S., 1 Rutland-street, Regents-park, N.W.
April 27, 1866	Lewis, R. T., F.R.M.S., 1 Lowndes-terrace, Knightsbridge, S.W.
June 26, 1868	Lindley, W., Jun., Kidbrook-terrace, Blackheath, S.E.
June 25, 1869	Linford, John S., 146 Holborn Bars, W.C.
Dec. 18, 1868	Lloyd, Henry, George-street, Richmond, S.W.
Nov. 24, 1865	Loam, Michael, Hampton, Middlesex, S.W.
Apl. 23, 1869	Long, Henry, 90 High-street, Croydon.
Jan. 26, 1866	Lord, J. K., F.Z.S., Elm-house, Denmark-hill, S.E.
July 7, 1865	Loveday, J., 5 Clarence-terrace, Seven-sisters-road, N.
Nov. 24, 1865	Lovibond, J. W., F.R.M.S., 4 Blue-stile, Greenwich-road, S.E.

Date of Election.	
Sept. 22, 1865	Lovick, T., Board of Works, Spring-gardens, S.W.
May 28, 1869	Lowe, Henry W., Clifton-villas, Albert-road, South Norwood, S.E.
Dec. 18, 1868	Lowne, Benjamin Thompson, M.R.C.S., 2 Guildford-street, Russell-square, W.C.
April 27, 1866	Loy, W. T., F.R.M.S., 9 Garrick Chambers, Garrick-street, W.C.
Jan. 24, 1868	Macdonald, J., M.D., 68 Upper Kennington-lane, S.E.
Nov. 23, 1866	McIntire, S. J., F.R.M.S., 22 Bessborough-gardens, S.W.
Oct. 25, 1867	McLeod, R. G., 38 Little Queen-street, W.C.
May 22, 1868	McVean, W., 18 Wood-street, E.C.
June 14, 1865	Marks, E., 25 Gloucester-road, Seven Sisters-road, N.
Dec. 28, 1866	Marsh, W. A., 325 Hackney-road, N.E.
June 26, 1868	Martin, James, 110 Regent-street, W.
Dec. 27, 1867	Martinelli, A , 106 Albany-street, N.W.
Oct. 25, 1867	Marwood, W. G. H., 68 Downham-road, Kingsland, N.
Dec. 22, 1865	Mason, J., Hampton, Middlesex, S.W.
April 26, 1867	Matthews, G. K., St. John's-lodge, Beckenham, Kent, S.E.
May 28, 1869	Matthews, Henry, 60 Gower-street, W.C.
Oct. 26, 1866	Matthews, John, M.D., 4 Mylne-street, Myddelton-square, E.C.
June 28, 1867	Matthews, Peter, L.D.S., F.Z.S., F.R.M.S., 17 Lower Berkeley-street, W.
Aug. 27, 1869	Mavor, William Samuel, 91 Park-street, Grosvenor-square, W.
July 7, 1865	May, W. R., 20 Trinidad-place, Islington, N.
Mar. 22, 1867	Meacher, John W., 10 Hillmarten-road, Camden-road, N.
Dec. 18, 1868	Mestayer, Richard, F.L.S., F.R.M.S., 13 Manor-road, Upper Holloway, N.
Mar. 19, 1869	Midwinter, Edward, 68 Snow Hill, E.C.
May 28, 1869	Millar, John, M.D., F.L.S., G.S., R.M.S., &c., Bethnal House, Cambridge Road, N.E.
June 26, 1868	Milledge, Alfred, 4 Upper Winchester-road Stanstead-road, Forest-hill, S.E.
Sept. 28, 1866	Miller, Benj., F.R.M.S., 49 Maddox-street, Bond-street, W.

Date of Election.	
July 7, 1865	Millett, F. W., 15 Alfred-street, River-terrace, N.
June 25, 1869	Moggridge, Matthew, F.G.S., 2 Montague villas, Richmond, Surrey.
May 25, 1866	Moginie, W., F.R.M.S., 35 Queen-square, W.C.
Mar. 27, 1868	Moore, Daniel, M.D., High-street, Hastings.
Oct. 26, 1866	Moore, S. W., St. Thomas's Hospital, S.E.
Oct. 27, 1865	Morrieson, Colonel, R., F.R.M.S., Oriental Club, Hanover-square, W.
Mar. 27, 1868	Morris, J. W., F.L.S. *(President of the Bath Microscopical Society)*, 15 Belmont, Bath.
July 26, 1867	Mott, H. H., 47 Union-grove, Clapham, S.W.
April 24, 1868	Mummery, J. Rigden, F.L.S., F.R.M.S., 10 Cavendish-place, W.
April 24, 1868	Mummery, J. Howard, 10 Cavendish-place, W.
Dec. 18, 1868	Mundie, George, M.R.C.S., 93 Richmond-road, Dalston, N.E.
Jan. 25, 1867	Murray, R. C., 69 Jermyn-street, St. James, S.W.
Sept. 27, 1867	Nash, Thompson, 101 Mortimer-road, De Beauvoir-square, N.
Mar. 23, 1866	Nation, W.J., 30 King-square, Goswell-road, E.C.
Jan. 26, 1866	Newman, W., 5 Oval-road, Kennington, S.E.
Dec. 18, 1868	Nicholas, T., Ph.D., F.G.S., 3 Craven-street, W.C.
July 7, 1865	Nicholson, D., 51 St. Paul's-churchyard, E.C.
April 26, 1867	Norman, John, Jun., 178 City-road, E.C.
Nov. 23, 1866	Norton, Arthur, St. Mary's Hospital, W.
Dec. 22, 1865	Nunn, C. G., Hampton, Middlesex, S.W.
April 26, 1867	Oakley, J. J., F.R.M.S., 183 Piccadilly, W.
Mar. 27, 1868	Oakeshott, John, High-street, Highgate, N.
Dec. 27, 1867	Osborn, C. E., 28 Albert-road, St. John's-ville, Highgate, N.
Dec. 27, 1867	Oxley, F., 60 Hungerford-road, Islington, N.
Nov. 27, 1868	Parker, T., 10 Brunswick-square, Camberwell, S.E.
April 27, 1866	Parsons, S., M.D., 10 Grafton-street, Bond-street, W.
June 25, 1869	Pass, H., 11 Spring-terrace, Wandsworth-road, S.W.
May 24, 1867	Pearce, G. T., 4 Bedford-row, Clapham-rise, S.W.

Date of Election.	
May 22, 1868	Pearsall, J. S., 38 Denbigh-street, Pimlico, S.W.
May 24, 1867	Pearson, John, 87 Edgware-road, W.
May 28, 1869	Pepler, W. B., Market Lavington, Wilts.
Oct. 25, 1867	Peppin, S. H., 25 Princes-street, Leicester-square, W.
July 23, 1869	Perry, F. J., 46 Bookham-street, Hoxton, N.
Oct. 27, 1865	Pickard, J. F., 32½ Colonnade, Russell-square, W.C.
Jan. 22, 1869	Pillischer, M., F.R.M.S., 88 New Bond-street, W.
June 25, 1869	Pocock, Lewis, Jun., 70 Gower-street, W.C.
July 23, 1869	Pocock, Thomas Willmer, 10 Ampthill-square, N.W.
Feb. 22, 1867	Pollock, Timothy, M.D., F.R.C.S., 26 Hatton-garden, E.C.
Nov. 23, 1866	Potter, G., F.R.M.S., 42 Grove-road, Upper Holloway, N.
June 22, 1866	Powe, I., St. John's, Richmond, Surrey.
May 25, 1866	Powell, Hugh, F.R.M.S., 170 Euston-road, N.W.
June 25, 1869	Powell, Llewellyn, M.R.C.S., 24 Cloudesley-street, Islington, N.
July 7, 1865	Powell, Thomas, 18 Doughty-street, Mecklenberg-square, W.C.
Oct. 26, 1866	Praill, Edward, 39 Mornington-road, N.W.
Dec. 27, 1867	Preston, H. B., 1 Devonshire-road, Liverpool.
Jan. 26, 1866	Price, D.S., Ph.D., F.C.S., 26 Great George-street, Westminster, S.W.
Feb. 22, 1869	Prichard, Thomas, M.D., Abbington Abbey, Northampton.
Nov. 27, 1868	Pritchett, Benjamin, 131 Fenchurch-street, E.C.
July 26, 1867	Pritchett, Francis, 131 Fenchurch-street, E.C.
April 23, 1869	Quekett, Arthur Edwin, 13 Delamere-crescent, Westbourne-square, W.
April 23, 1869	Quekett, Alfred J. S., 13 Delamere-crescent, Westbourne-square, W.
April 23, 1869	Quekett, Rev. William, The Rectory, Warrington.
Feb. 23, 1866	Quick, George E., 109 Long-lane, Bermondsey, S.E.
Oct. 26, 1866	Rabbits, W. T., Selwood, Mayow-road, Forest-hill, S.E.
Nov. 23, 1866	Radermacher, J. J., 21 Tregunter-road, Boltons, West Brompton, S.W.

Date of Election.	
Oct. 26, 1866	Ramsbotham, J. M., M.D., 15 Amwell-street, Pentonville, E.C.
Oct. 26, 1866	Ramsden, Hildebrand, M.A., F.L.S., F.R.M.S., Forest-rise, Walthamstow, N.E.
Aug. 28, 1868	Rance, T. G., Widmore-lane, Bromley, Kent.
May 22, 1868	Rawles, W., 64 Kentish-town-road, N.W.
Dec. 18, 1868	Redl, C. A., 11 Upper Wimpole-street, W.
July 7, 1865	Reeves, W. W., F.R.M.S., 37 Blackheath-hill, Greenwich, S.E.
April 24, 1868	Reynolds, John, 23 Chadwell-street, Pentonville, E.C.
Jan. 24, 1868	Ricca, Alexis, 2 Great St. Helens, E.C.
July 23, 1869	Richards, Samuel A., L.R.C.P., M.R.C.S., 153 Upper Kennington-lane, S.E.
Jan. 24, 1868	Richardson, C. J., 44 Duncan-terrace, Islington, N.
Dec. 22, 1865	Richardson, C. T., M.D., 36 Dorset-square, N.W.
Oct. 25, 1867	Riddell, W., 2 Stowe-villas, Philip-lane, Tottenham, N.
Feb. 23, 1866	Rixon, F., F.R.M.S., Loats-road, Clapham-park, S.W.
June 25, 1869	Roberts, John H., F.R.C.S., F.R.M.S., 20 New Finchley-road, St. John's-wood, N.W.
Feb. 22, 1867	Roberts, Samuel, M.A., 3 Junction-villas, Junction-road, Upper Holloway, N.
May 24, 1867	Robey, James, F.R.M.S., Newcastle, Staffordshire.
May 22, 1868	Rogers, John, 14 Bramah-road, Brixton, S.W.
Oct. 26, 1866	Rogers, Jos. R., 12 Bellefield-terrace, Bellefields-road, Stockwell, S.W.
Oct. 26, 1866	Rogers, Thos., Mortlock-house, Loughborough-road, Brixton, S.W.
April 24, 1868	Rogerson, John, F.R.M.S., care of Mr. H. Crouch, 54 London-wall, E.C.
May 22, 1868	Roper, F. C. S., F.L.S., F.G.S., F.R.M.S., 157 Madai-vale, W.
Sept. 28, 1866	Ross, Thomas, F.R.M.S., 53 Wigmore-street, W.
July 24, 1868	Rowe, James, Jun., M.R.C.V.S., 65 High-street, Marylebone, W.
Oct. 26, 1866	Rowlett, John, 8 Regent-street, S.E.
May 28, 1869	Rowley, W. J., 28 Hunter-street, Brunswick-square, W.C.
June 14, 1865	Ruffle, G. W. (*Curator*), 131 Blackfriars-road, S.E.

Date of Election.

Mar. 22, 1866	Russell, Rev. F. W., F.R.M.S., Charing Cross Hospital, W.C.
Oct. 27, 1865	Russell James, 4 Lansdowne-terrace, London-fields, Hackney, N.E.
Oct. 26, 1866	Russell, Joseph, F.R.M.S., Cumberland-lodge, Brixton-hill, S.W.
May 22, 1868	Russell, Thomas, Westbourne-park-villas, W.
Feb. 22, 1867	Rutter, H. Lee, 2 Clifton-villas, Lansdown-circus, South Lambeth, S.W.
Nov. 22, 1867	Sanford, John, 30 Willes-road, Kentish-town, N.W.
April 26, 1867	Scadding, H., 9 New Turnstile, Holborn, W.C.
Dec. 18, 1868	Scantlebury, William, 7 Wells-street, Gray's-inn-road, W.C.
May 22, 1867	Scatliff, John Parr, M.D., 132 Sloane-street, S.W.
May 28, 1869	Scoble, Samuel W., 25 James-street, Covent-garden, W.C.
May 25, 1866	Sedgwick, L W., M.D., 2 Gloucester-terrace, Hyde-park, W.
July 27, 1868	Sewell, Richard, Princes-road, Lambeth, S.E.
July 27, 1866	Sharpey, W., M.D., F.R.S., 33 Woburn-pl., W.C.
May 24, 1867	Shave, W., 38 Sidmouth-st., Regent's-square, W.C.
Jan. 22, 1869	Sheehy, William H., M.D., 4 Claremont-square, N.
Aug. 23, 1867	Simmons, James J., L.D.S., F.R.M.S., 18 Burton-crescent, W.C.
May 28, 1869	Simonds, Professor J. B., F.R.M.S., Royal Veterinary College, N.W.
Dec. 27, 1867	Simons, Henry, Northumberland-house, Green-lanes, Stoke Newington, N.
Dec. 28, 1866	Simpson, J. Wharton, 36 Canonbury-park South, N.
Mar. 27, 1868	Simson, Thos., St. John's-villa, Upper Lewisham road, S.E.
May 28, 1869	Sketchley, H. G., 10 Ampthill-square, N.
Dec. 28, 1866	Slade, J., 103 St. John's-street-road, E.C.
Oct. 23, 1868	Smart, William, 27 Aldgate, E.
May 25, 1866	Smith, Alpheus, 2 Hanover-place, Rye-lane, Peckham, S.E.
May 25, 1866	Smith, Charles E., Stanmore-villa, Beulah-hill, Upper Norwood, S.E.

Date of Election.	
Dec. 27, 1867	Smith, Geo. J., 112 Packington-street, Islington, N.
Oct. 26, 1868	Smith, H. Ambrose, 5 Lothbury, E.C.
June 26, 1868	Smith, James, F.L.S., F.R.M.S., 5 Willow-cottages, Canonbury, N.
May 22, 1868	Smith, James John, F.R.M.S., 56 Tollington-rd. N.
April 23, 1869	Smith, Vernon, 37 Tavistock-square, W.C.
April 23, 1869	Snartt, T. G., 126 Englefield-road-west, N.
April 24, 1868	Snellgrove, W., 22 Surrey-square, S.E.
Sept. 22, 1865	Southwell, C , 44 Princes-street, Soho, W.
Dec. 18, 1868	Sowerby, D., 38 Albert-road, Dalston, N.E.
May 22, 1868	Spencer, John, White-house, Croydon.
Dec. 28, 1866	Spicer, Rev. W. W., F.R.M.S., Courthill-house, Potterne, Devizes.
Nov. 23, 1866	Spurrell, F. C. J., F.R.M.S., Belvidere, Kent, S.E.
Mar. 24, 1865	Starling, Benjamin, 11 Gray's-inn-square, W.C.
Nov. 23, 1866	Steet, G. C., F.R.C.S., 21 Myddelton-square, E.C.
Aug. 24, 1866	Steward, J. H., F.R.M.S., 406 Strand, W.C.
Mar. 19, 1869	Stokes, Frederick, 31 Lincoln's-inn-fields, W.C.
July 1, 1866	Suffolk, W. T., F.R.M.S., Claremont-lodge, Park-street, Camberwell, S.E.
Nov. 22, 1867	Swainston, J. T., 1 Victoria-road, Buckingham-gate, S.W.
Nov. 24, 1865	Swansborough, E., 6 Great James-street, Bedford row, W.C.
Dec. 18, 1868	Swift, James, 15 Kingsland-road, N.
June 26, 1868	Syms, F.R., 18 Manor-terrace, Brixton, S.W.
Nov 22, 1867	Tarner, A. P , F.C.S., 97 High-st., Marylebone, W.
May 22, 1868	Tatem, J. G , Russell-street, Reading.
Dec. 22, 1865	Terry, J., 109 Borough-road, S.E.
May 28, 1869	Thairlwall, F. J., 169 Gloucester-road, Regents-park, N.W.
July 23, 1869	Thin, James, Ormiston-lodge, Claremont-place, Brixton-road, S.W.
Jan. 24, 1868	Tomkins, Samuel Leith, 26 Buckland-crescent, Belsize-park, N.W.
Oct. 26, 1866	Topping, C. M., A.R.M.S., 11 Loader's-terrace, Manor-road, Bermondsey, S.E.
July 23, 1869	Trotter, Joseph, Scarborough.
July 24, 1868	Tulk, John A., M.D., Spring-grove, Isleworth, W.

Date of Election.	
July 24, 1868	Tulk, John A., F.R.M.S., &c., Firfield, Addlestone, Weybridge.
July 26, 1867	Turnbull, Joseph, 1 Clifton-villas, Highgate-hill, N.
Nov. 24, 1865	Turner, H., 77 Fleet-street, E.C.
June 25, 1869	Turner, R. D., Chafford, Tunbridge
Mar. 27, 1868	Tuson, Professor Richard V., Royal Veterinary College, N.W.
Mar. 27, 1868	Vallentin, J. Rose, 55 Cow-cross-street, E.C.
July 27, 1866	Veitch, Harry, F.H.S., The Royal Exotic Nursery, King's-road, Chelsea, S.W.
Feb. 23, 1866	Walker, A., M.D., 16 Keppel-street, Russell-square, W.C.
May 28, 1869	Walker, Henry, 100 Fleet-street, E.C.
June 26, 1868	Walker, J. W., Fairfield-house. Watford.
Mar. 22, 1867	Wall, Alfred J., 46 Bessborough-st., Pimlico, S.W.
Dec. 18, 1868	Waller, Arthur, F.R.M.S., 11 Aberdeen-park, Highbury, N.
May 22, 1868	Waller, J. G., 68 Bolsover-street, Portland-road, W.
Oct. 27, 1865	Wallis, George, South Kensington Museum, S.W.
Nov. 22, 1867	Ward, F. H., Springfield House, near Tooting, Surrey.
Dec. 18, 1868	Warner, Alfred, 102 Christian-street, Commercial-road, E.
Feb. 26, 1869	Warner, William, 102 Christian-street, Commercial-road, E.
May 25, 1866	Warrington, H. R., 18 Upper Barnsbury-street, N.
Oct. 27, 1865	Watkins, C. A., 10 Greek-street, Soho, W.
May 22, 1868	Watson, Thos. D., 18A Basinghall-street, E.C.
Sept. 22, 1865	Watson, T. G., 43 Poland-street, Oxford-street, W.
Sept. 25, 1868	Waugh, J. W. Spencer, 4 Maitland-park-villas, Haverstock-hill, N.W.
Aug. 23, 1867	Way, John, M.D., 4 Eaton-square, S.W.
Dec. 28, 1866	Way, T. E., 29 Wigmore-street, W.
Jan. 22, 1869	Webb, George, Buckhurst-hill, Essex.
May 24, 1867	Weeks, A. W. G., 18 Gunter's-grove, Chelsea, S.W.
May 28, 1869	Welsh, W., Wells, Somerset.
July 7, 1865	West, H., 41 Strand, W.C.

Date of Election.	
Dec. 22, 1865	West, W., 54 Hatton-garden, E.C.
Dec. 22, 1865	Western, G., F.R.M.S., 42 Gerrard-st., Soho, W.
Aug. 4, 1865	Westgarth, W.
Dec. 28, 1866	Wheldon, W., F.R.M.S., 58 Great Queen-street, W.C.
Apl. 23, 1869	White, Charles Frederick, F.R.M.S., 42 Windsor-road, Ealing.
Oct. 26, 1866	White, F., 1 New-road, Commercial-road-east, E.
Feb. 26, 1868	White, Francis W., 2 Gipsy-hill-villas, Norwood, S.E.
May 22, 1868	White, T. Charters, M.R.C.S., F.R.M.S. (*Secretary*), 32 Belgrave-road, S.W.
May 24, 1867	White, W., F.R.M.S., 14 Park-terrace, Highbury, N.
July 24, 1868	Wight, James F., F.R.M.S., Chesnut-villa, Gipsy-road, Norwood, S.E.
May 22, 1868	Wigner, John M., B.A., B.Sc., 16 Grove Hill-terrace, Grove-lane, Camberwell, S.E.
May 22, 1868	Wild, E. G., 23 Acacia-road, St. John's-wood, N.W.
Nov. 22, 1867	Williams, R., 95 Queen's-crescent, Haverstock-hill, N.W.
Nov. 23, 1866	Willsmer, J., 98 Carlton-road, Kentish-town, N.W.
Jan. 25, 1867	Willsworth, H., 7 Whittington-terrace, Upper Holloway, N.
Feb. 23, 1866	Wilshin, J., 12 Totford-place, Neckinger, Bermondsey, S.E.
Feb. 22, 1867	Wilson, Frank, 110 Long-acre, W.C.
April 24, 1868	Withall, Henry, 1 The Elms, St. John's-road, Brixton, S.W.
May 28, 1869	Wood, Charles H., F.C.S., 25 Devonshire-road, Holloway, N.
Sept. 22, 1865	Wood, E. G., 74 Cheapside, E.C.
Aug. 27, 1869	Woods, S. Fell, 1 Park-hill, Forest-hill, S.E.
Oct. 25, 1867	Worthington, Richard, Champion-park, Denmark-hill, S.E.
Nov. 23, 1866	Wright, Edw., 23 Ashley-crescent, City-road, N.
Aug. 4, 1865	Wyatt, C. C., 9 North Audley-street, W.

Oct. 26, 1866	Yeats, Christopher, Mortlake, Surrey, S.W.
April 26, 1867	Young, J. T., 32 Mount-street, New-road, White-chapel, E.

RULES.

I.—That "The Quekett Microscopical Club" hold its meetings at University College, Gower Street, on the fourth Friday Evening in every month, at Eight o'clock precisely, or at such other time or place as the Committee may appoint.

II.—That the business of the Club be conducted by the President, four Vice-Presidents, the Treasurer, the Honorary Secretary, the Honorary Secretary for Foreign Correspondence, and a Committee of twelve other members. Six to form a quorum. That the Editor of the Journal be *ex officio* an additional member of the Committee. That the President, Vice Presidents, Treasurer, and two Secretaries, with the four senior members of the Committee (by election) retire annually, but be eligible for re-election.

III.—That at the ordinary Meeting in June, nominations be made of Candidates to fill the offices of Vice-Presidents and vacancies on the Committee. That such nominations be made by resolutions duly moved and seconded, no Member being entitled to propose more than one Candidate. That in the event of such nominations exceeding one half more than the number of vacant offices, the Candidates be reduced by show of hands to such proportion. That the President, Treasurer, and Honorary Secretary for Foreign Correspondence be nominated by the Committee. That a list of all nominations made as above be printed in alphabetical order upon the ballot paper. That at the Annual General Meeting in July all the above officers be elected by ballot from the candidates named in the lists, but any member is at liberty to substitute on his ballot-paper any other name or names in lieu of those nominated for the offices of President, Treasurer, Honorary Secretary, and Honorary Secretary for Foreign Correspondence.

IV.—That in the absence of the President and Vice-Presidents the Members present at any ordinary Meeting of the Club elect a Chairman for that evening.

V.—That every Candidate for Membership be proposed by two or more Members, who shall sign a certificate (see Appendix) in recommendation of him—one of the proposers from personal knowledge. The certificate shall be read from the chair, and the Candidate therein recommended ballotted for at the following Meeting. Three black balls to exclude.

VI.—That the Society include not more than twenty Foreign Honorary Members, elected by the Members by ballot, upon the recommendation of the Committee.

VII.—That the Annual Subscription be Ten Shillings, payable in advance on the 1st of July, but that any Member elected in May or June be exempt from subscription until the following July. That any Member desirous of compounding for his future subscriptions may do so at any time by payment of the sum of Ten Pounds; all such sums to be duly invested in such manner as the Committee shall think fit. That no person be entitled to the full privileges of the Club until his subscription shall have been paid; and that any Member omitting to pay his subscription six months after the same shall have become due (two applications in writing having been made by the Treasurer) shall cease to be a Member of the Club.

VIII.—That the accounts of the Club be audited by two Members, to be appointed at the ordinary Meeting in June.

IX.—That the Annual General meeting be held on the fourth Friday in July, at which the Report of the Committee on the affairs of the Club, and the Balance Sheet duly signed by the Auditors shall be read. Printed lists of Members nominated for election as President, Vice Presidents, Treasurer, Secretaries, and Members of the Committee having been distributed, and the Chairman having appointed two or more Members to act as Scrutineers, the Meeting shall then proceed to ballot. If from any cause these elections, or any of them, do not take place at this Meeting, they shall be made at the next ordinary Meeting of the Club.

X.—That at the ordinary Meetings the following business be transacted:—The minutes of the last Meeting shall be read and confirmed; donations to the Club since the last Meeting announced and exhibited; ballots for new Members taken; papers read and

discussed; and certificates for new Members read; after which the Meeting shall resolve itself into a conversazione.

XI.—That any Member may introduce a Visitor at any ordinary Meeting, who shall enter his name with that of the Member by whom he is introduced, in a book to be kept for the purpose.

XII.—That no alteration be made in these Laws, except at an Annual General Meeting, or a Special General Meeting called for that purpose; and that notice in writing of any proposed alteration be given to the Committee, and read at the ordinary Meeting, at least a month previous to the Annual or Special Meeting, at which the subject of such alteration is to be considered.

APPENDIX.

QUEKETT MICROSCOPICAL CLUB.

Mr.
of
being desirous of becoming a Member of this Club, we beg to recommend him for election.

(on my personal knowledge).

This Certificate was read 186
The Ballot will take place 186

RULES FOR THE EXCHANGE OF SLIDES.

I. That all Slides be deposited with the Exchange Committee.

II. That not more than two similar Slides be placed in the Exchange Box at one time by any one Member.

III. That the Slides be classified by the Committee into Sections, numbered according to quality.

IV. Members to select from the class in which their Slides are placed, at the ordinary meetings of the Club.

V. Members may leave the selection to the Exchange Committee, if they prefer it.

VI. Slides once exchanged cannot be exchanged again.

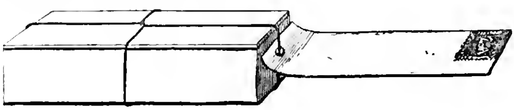
VII. A Register shall be kept, in which the Slides deposited shall be entered and numbered, with the date of receipt, and in which exchanges shall also be noted.

VIII.—All expenses incurred in the transmission of Slides, or in correspondence respecting them, to be borne by the Member on whose account such charges may be incurred.

Parcels may be addressed—

Mr. T. Charters White,
192, Piccadilly,
London, W.
[Exchange.]

Note.—As much inconvenience frequently arises from the breakage of Slides in transmission through the Post, the following method is recommended:—Pack the Slides in a small wooden box, which can be obtained of any Optician, tie it securely with string and attach a slip of parchment to one end, sufficiently large to receive the Postage Stamps, Address, and local Post-office Stamps during transmission.



If paper be used as a wrapper to the box, the colour should be *black*.

When twelve or more Slides are sent, they should be packed in a racked box and forwarded by Railway.

QUEKETT MICROSCOPICAL CLUB,

MEETING AT

UNIVERSITY COLLEGE, GOWER STREET, LONDON.

The Ordinary Meetings will be held on the following Friday Evenings, at Eight o'clock.

1869.—	August	27.
	September	24.
	October	22.
	November	26.
	December	17.
1870.—	January	28.
	February	25.
	March	25.
	April	22.
	May	27.
	June	24.

Extra Meetings for Conversation and Exhibition of Objects only, will be held on the Second Friday of every month, at 7 o'clock.

The Annual General Meeting July 22nd, 1870, at Eight o'clock.

Offices, 192, Piccadilly.